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A monthly publication of the Geological Survey
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As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

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Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
U.S. Geological Survey
MS 425 National Center
Reston, VA 22092

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SELECTED WATER RESOURCES ABSTRACTS

2. WATER CYCLE

2A. General

BOUSSINESQ'S EQUATION SOLUTIONS FOR SEMI-INFINITE AQUIFER,
National Technical Univ., Athens (Greece). Dept. of Civil Engineering.
G. Noutsopoulos, T. Papathanassiadis, and I. Gavriilidis.
Journal of Hydraulic Engineering, Vol. 110, No. 8, p 1155-1161, August, 1984. 1 Fig, 2 Tab, 13 Ref.

Descriptors: *Unsteady flow, *Unconfined aquifers, *Mathematical equations, *Boussinesq's Equation, Flow, Aquifers.

The problem of unsteady flow in an unconfined semi-infinite aquifer adjacent to a surface reservoir, both resting on a horizontal impervious stratum, has attracted the interest of many investigators. If the system of aquifer-reservoir is initially considered at rest with a horizontal free water surface throughout, flow in the aquifer may be initiated under the following conditions: changes of water level in the reservoir; artificial or natural recharge of the aquifer; and any combination of these conditions. The proposed approximate analytical solutions for the case of instantaneous lowering of the free surface in a reservoir are critically reviewed and compared to the more accurate numerical ones for the purpose of defining the best approximate analytical solution. The problem is mathematically formulated on the basis of hydraulic theory for homogeneous and isotropic porous medium. (Baker-IVI)
W85-02269

SUGGESTION FOR A COUPLED MODEL OF SURFACE AND GROUNDWATER SIMULATION ON A WATERSHED (PROPOSITION D'UN MODELE COUPLE POUR LA SIMULATION CONJONTE DES ECOULEMENTS DE SURFACE ET DES ECOULEMENTS SOUTERRAINS SUR UN BASSIN HYDROLOGIQUE),
Ecole Nationale Superieure des Mines de Paris, Fontainebleau (France). Centre d'Information Geologique.
E. Ledoux, G. Girard, and J. P. Villeneuve.
Houille Blanche, No. 1/2, p 101-110, 1984. 15 Fig, 11 Ref.

Descriptors: *Model studies, *Surface water, *Flow, *Groundwater flow, Drainage, Runoff.

An integrated modelling method is described for surface water and groundwater flow in a drainage area. The model is based on a breakdown of the water cycle in spatial terms. Theoretical principles with respect to the way the model's structure was computed are examined. Attention is also given to the calculation of the groundwater inventory at ground level, run-off to the unsaturated zone and associated surface and subsurface flow patterns. Practical application is described based on the Caramy drainage area in the South of France. How the coupled model is applied to a structure which has very heterogeneous physiographical and hydrological characteristics is considered. (Baker-IVI)
W85-02354

TREATMENT OF EVAPOTRANSPIRATION, SOIL MOISTURE ACCOUNTING, AND AQUIFER RECHARGE IN MONTHLY WATER BALANCE MODELS,
Geological Survey, Reston, VA. Water Resources Div.
W. M. Alley.
Water Resources Research, Vol. 20, No. 8, p 1137-1149, August, 1984. 5 Fig, 6 Tab, 31 Ref.

Descriptors: *Evapotranspiration, *Soil water, *Aquifer recharge, *Hydrologic budget, Model studies, Precipitation, Drought, Thornthwaite-Mather model, Palmer model, Thomas abcd model, Forecasting, Groundwater storage.

Several two- to six-parameter regional water balance models are examined by using 50-year records of monthly streamflow at 10 sites in New Jersey. These models include variants of the Thornthwaite-Mather model, the Palmer model, and the more recent Thomas abcd model. Prediction errors are relatively similar among the models. However, simulated values of state variables such as soil moisture storage differ substantially among the models, and fitted parameter values for different models sometimes indicated an entirely different type of basin response to precipitation. Some problems in parameter identification are noted, including difficulties in identifying an appropriate time lag factor for the Thornthwaite-Mather-type model for basins with little groundwater storage, very high correlations between upper and lower storages in the Palmer-type model, and large sensitivity of parameter a of the abcd model to bias in estimates of precipitation and potential evapotranspiration. Modifications to the threshold concept of the Thornthwaite-Mather model were statistically valid for the six stations in northern New Jersey. The abcd model resulted in a simulated seasonal cycle of groundwater levels similar to fluctuations observed in nearby wells by with greater persistence. These results suggest that extreme caution should be used in attaching physical significance to model parameters and in using the state variables of the models in indices of drought and basin productivity. (Author's abstract)
W85-02370

TESTS FOR DETECTING A SHIFT IN THE MEAN OF HYDROLOGICAL TIME SERIES,
Royal Netherlands Meteorological Inst., De Bilt.
T. A. Buishand.
Journal of Hydrology, Vol. 73, No. 1/2, p 51-69, July, 1984. 3 Fig, 2 Tab, 16 Ref.

Descriptors: *Hydrologic models, *Mathematical studies, Time series analysis, Statistical methods, Rainfall-runoff relationships.

A practical problem in time series analysis of hydrological and meteorological data is to find statistical techniques for testing for an abrupt change in the mean at an unknown time. Suitable techniques have been developed in the situation of a single time series. Attention is paid to the likelihood ratio statistic and to a Bayesian statistic. Critical values are derived for the latter. Testing for a systematic change in a linear regression model is discussed. Examples are presented of annual precipitation and runoff from the River Colorado Basin near Grand Canyon, Arizona and the January precipitation and runoff for the River Thames Basin above Teddington, England. Regression of streamflow data on precipitation data gives a variance reduction which improves the power of statistical tests. Another reason for using a regression relation between streamflow and precipitation is to eliminate serial correlation effects. (Baker-IVI)
W85-02458

SYSTEMATIC PROBLEM-ORIENTED APPROACH TO HYDROLOGICAL DATA REGIONALISATION,
Vrije Univ., Amsterdam (Netherlands). Dept. of Hydrogeology and Geographical Hydrology.
I. Simmers.
Journal of Hydrology, Vol. 73, No. 1/2, p 71-87, July, 1984. 1 Fig, 5 Tab, 62 Ref.

Descriptors: *Regionalization, *Decision making, Reviews, Hydrologic data collections, Mapping, Statisitcal studies, Remote sensing.

The development of hydrological data regionalization is reviewed and, on the basis of recent work, attempts are made to rationalize the steps involved in its practical application. A systematic problem-oriented matrix is presented which enables the user to readily identify techniques at present most appropriate to a given problem. The overall process can be viewed as an hierarchical problem-oriented decision-making procedure which does not allow development of a single robust universally-applicable model. In most cases the process is optimally suited to an integrated multidisciplinary systematic approach, involving a combination of mapping, statistical and remote-sensing techniques. (Baker-IVI)
W85-02459

EFFECT OF PRECIPITATION MAXIMUMS ON THE SPECIES SYNTHESIS OF THE AGROPHYTOCENOSES OF THE SAND RIDGE BETWEEN THE DANUBE AND TISZA,
Gy. Bodrogkozy.
Acta Biologica (Nova Series), Vol. 29, No. 1-4, p 101-116, 1983. 13 Fig, 1 Tab, 9 Ref.

Descriptors: *Precipitation, *Hungary, *Vegetation, *Agrophytocenoses, Sand, Ecological distribution, Soil type.

In lowland regions, water has the greatest effect on the plant species synthesis. In the southern regions of the sand ridge located between the Danube and Tisza of the Great Hungarian Plain a study of precipitation maximums and their effects was carried out. During the course of evaluating the changes in the species of agrophytocenoses, 30 subunits were formed, which fall into 10 categories according to moisture demand. A correlation was noted between certain Consolido-Eragrostion minoris and Tribulo-Eragrostion minoris associations and the range of their soil- and subtypes. With the help of a vegetation map prepared for the area around the village of Tazlar, conclusions may be drawn regarding the various degrees of the danger of inland waters arising from precipitation maximums. (Baker-IVI)
W85-02474

APPLICATIONS OF THE LOG PEARSON TYPE-3 DISTRIBUTION IN HYDROLOGY,
Asian Inst. of Tech., Bangkok (Thailand).
H. N. Phien, and T. Jivajirajah.
Journal of Hydrology, Vol. 73, No. 3/4, p 359-372, August, 1984. 10 Tab, 12 Ref.

Descriptors: *Hydrological models, *Flood frequency, Distribution, Rainfall, Precipitation, Rainfall intensity, Streamflow, *Statistical models, *Pearson distribution.

Although the log Pearson (LP3) type-3 distribution was recommended specifically for flood-frequency analysis, its applicability to annual maximum rainfall, annual streamflow and annual rainfall was also considered. Three methods which were found to be best for estimating the parameters of the LP3 distribution are summarized for use in fitting this distribution to several samples of annual flood, annual maximum rainfall, annual streamflow and annual rainfall selected from different sources. The chi-square and Kolmogorov-Smirnov tests are used to evaluate the goodness-of-fit involved. The method of maximum likelihood, with the new method of solution based upon the Newton-Raphson procedure may fail to converge more often than the other two methods of mixed moments. With respect to the goodness-of-fit tests, the LP3 distribution is applicable to all the above four data types. For annual flood and annual maximum rainfall intensities, the existence of an upper bound, corresponding to the occurrence of negative values for the shape parameter a, may cause some concern. For those cases where a is negative, the LP3 distribution should be considered unsuitable. In contrast to the aforementioned two types of maximum values, the existence of an upper bound is well accepted for annual streamflow data, and possibly for annual rainfall data as well. It seems then that the LP3 distribution is suitable for these two data types, especially when one remembers that it is more flexible than the Pearson type-3 distribution. (Baker-IVI)
W85-02494

NOTE ON ESTIMATING THE UNIT HYDROGRAPH (EFFECTIVE RAINFALL UNKNOWN),
Waikato Univ., Hamilton (New Zealand). Dept. of Earth Sciences.
W. E. Bardsley, and R. A. Petch.
Journal of Hydrology, Vol. 73, No. 3/4, p 383-388, August, 1984. 1 Tab, 3 Ref.

Descriptors: *Hydrologic models, *Hydrographs, *Rainfall, Computers, Linear programming, Optimization.

When effective rainfalls are unknown, estimates of the unit hydrograph can be made using general

nonlinear optimization techniques. Such techniques have a disadvantage in that there is no guarantee against convergence to a suboptimal solution. An alternative approach is outlined where the original problem is reformulated so as to be amenable to solution by a mixed integer linear programming algorithm. The alternative method can approximate the optimum solution to any degree of accuracy, subject to computer requirements. The procedure outlined is not the only form of linear approximation available. The present approach is more natural in that a discrete approximation to the unit hydrograph can be readily visualized. The methodology is similar to that of applying linear programming techniques to a discrete form of the tritium input function. An advantage of the integer hydrograph is that an impression is gained of the accuracy of the corresponding estimate of the unit hydrograph. (Baker-IVI)
W85-02496

FROM EXCESS INFILTRATION TO AQUIFER RECHARGE: A DERIVATION BASED ON THE THEORY OF FLOW OF WATER IN UNSATURATED SOILS,
Colorado State Univ., Fort Collins.
H. J. Morel-Seytoux.
Water Resources Research, Vol. 20, No. 9, p 1230-1240, September, 1984. 7 Fig, 3 Tab, 27 Ref. NSF grant CEE-8212668.

Descriptors: *Groundwater recharge, *Infiltration, *Unsaturated flow, Mathematical models, Percolation, Soil water, Aquifers.

A practical and versatile tool was developed to predict aquifer recharge from excess infiltration rates. The excess infiltration rate is the flux of water at a depth such that water below it is no longer subject to evapotranspiration. The approximate unit hydrograph of aquifer recharge due to effective percolation is derived from a theory describing flow of water in unsaturated soils. The parameters appearing in the expression of the unit hydrograph have physical meaning. Comparison of the theory with field observations indicates that the theory works well. The method is versatile because it can be adapted to almost any time step. It accounts for the seasonal character of the phenomenon. It is practical because the expression of the S curve is analytical and for a given soil and a given water table it depends on only two parameters. (Moore-IVI)
W85-02665

2B. Precipitation

RELATING RAINFALL EROSIVITY FACTORS TO SOIL LOSS IN KENYA,
Office of International Cooperation and Development (USDA), Washington, DC.
For primary bibliographic entry see Field 2J.
W85-02322

NOTE ON THE FORM OF DISTRIBUTIONS OF PRECIPITATION TOTALS,
Waikato Univ., Hamilton (New Zealand). Dept. of Earth Sciences.
W. E. Bardsley.
Journal of Hydrology, Vol. 73, No. 1/2, p 187-191, July, 1984. 1 Fig, 8 Ref.

Descriptors: *Precipitation, *Distribution patterns, *Poisson ratio, Mathematical studies.

This note is concerned with drawing attention to some properties of Poisson random sums which permit a few general statements to be made concerning the form of distributions of precipitation totals, independent of the knowledge of distributions of precipitation depth. A suggestion is also made for an estimation procedure for quantiles of rainfall totals, again independent of distributions of precipitation depth. For Poisson-distributed numbers of independent precipitation events, the precipitation totals are either approximately normally distributed (asymptotic case) or distributed with a positive skew and kurtosis greater than 3 (subasymptotic case). This result applies regardless of the forms of the unknown distributions governing precipitation amount per event. (Baker-IVI)
W85-02466

COMMON RELATIONSHIP BETWEEN PRECIPITATION AND GRASSLAND PEAK BIOMASS FOR EAST AND SOUTHERN AFRICA,
California Univ., Berkeley. Dept. of Zoology.
I. K. Deshmukh.
African Journal of Ecology, Vol. 22, No. 3, p 181-186, September, 1984. 2 Fig, 1 Tab, 18 Ref.

Descriptors: *Precipitation, *Africa, *Grasslands, Plant populations, Primary productivity, Vegetation, Biomass.

A compilation of data from East and southern Africa is used to establish a relationship between precipitation and peak biomass above ground in the herb layer to serve as a crude measure of primary production. Despite some scatter, the correlation between peak biomass and precipitation is highly significant when graphed. The least-squares regression line has a highly significant slope which predicts approximately 800 kg/ha peak biomass of vegetation for every 100 mm of rainfall received. The zero biomass intercept is equivalent to 23 mm of precipitation which closely agrees with earlier predictions of 20 mm. (Baker-IVI)
W85-02544

PHOSPHORUS BUDGETS OF INDOOR RESERVOIR MODELS VARYING IN SEDIMENT COMPOSITION AND WATER INLET SITE,
Ehime Univ., Matsuyama (Japan). Dept. of Environment Conservation.
For primary bibliographic entry see Field 2H.
W85-02620

2D. Evaporation and Transpiration

DATA REQUIREMENT FOR EVAPOTRANSPIRATION ESTIMATION,
Florida Univ., Gainesville. Dept. of Agricultural Engineering.
S. F. Shih.
Journal of Irrigation and Drainage Engineering, Vol. 110, No. 3, p 263-274, September, 1984. 2 Tab, 31 Ref.

Descriptors: *Evapotranspiration, *Estimating, *Climatology, Mathematical equations, Temperature effects, Solar radiation.

Various approaches based on climatological data (CD) have been used to estimate evapotranspiration (ET). A multiple regression with the ordinary least square (OLS) analysis has been commonly used to assess the relative importance of the CD which should be included in the ET equation. It is difficult to assess their relative importance in the OLS analysis when multicollinearity exists among the CD. This multicollinearity problem can be overcome by a statistical method called ridge regression analysis. Two years of daily climatological data in southern Florida are used to demonstrate the technique. Multicollinearity between air temperature and solar radiation was not observed, and the multiple correlation coefficient (R2) value in the case with these two variables is almost as good as in the case with all the variables. These results imply that the air temperature and solar radiation should be chosen as two important predictors for estimating the ET. For future improvement of the CD collecting programs, the air temperature and solar measurements should be urgently implemented. The multicollinearity problem existing among the CD is somewhat site-specific. In choosing an ideal ET equation, one should minimize input of the CD variables without affecting the accuracy of estimation, so that not only the multicollinearity problem can be eliminated but also the CD availability can be improved considerably. (Baker-IVI)
W85-02445

EVAPOTRANSPIRATION UNDER EXTREMELY ARID CLIMATES,
King Saud Univ., Riyadh (Saudi Arabia). Dept. of Civil Engineering.
A. M. A. Salih, and U. Sendil.
Journal of Irrigation and Drainage Engineering, Vol. 110, No. 3, p 289-303, September, 1984. 4 Fig, 7 Tab, 11 Ref.

Descriptors: *Evapotranspiration, *Estimating, *Saudi Arabia, Water supply, Developing countries, Arid regions, Irrigation requirements,.

Five estimation methods were evaluated for estimating monthly values of reference evapotranspiration (ETR) in a small catchment in Central Saudi Arabia. The selected methods are Class A Pan, Jensen-Haise, Hargreaves, Modified Penman and three versions of Blaney-Criddle. There were considerable differences in ETR values estimated by the methods. Comparative analyses were performed between the results estimated by different methods in each of the three inspected neighboring stations (Riyadh, Kharj, and Dirab) and by the same methods in different stations. Satisfactory correlations were noticed from all methods, except for Class A Pan whose values reflected doubtful results. There was a high degree of correlation between the monthly values estimated by Class A Pan, Jensen-Haise, and Hargreaves methods, tested at Hofuf and Riyadh with Kharj as a reference station. Although between them these methods have indicated remarkable correlation, each one of them has suggested a different value for ETR. Such differences are very serious when noting that most of these methods are currently used for estimating irrigation water requirements in many extremely arid areas. Each of the methods indicated much lower ETR values than those obtained by direct measurement. An evaluation of the individual methods has ranked Jensen-Haise method on top, followed by Class A Pan, Hargreaves method in third place, Modified Penman in fourth and Blaney-Criddle methods on the bottom of the scale. (Baker-IVI)
W85-02447

RESPONSES OF STOMATA AND LEAF GAS EXCHANGE TO VAPOUR PRESSURE DEFICITS AND SOIL WATER CONTENT, I. SPECIES COMPARISONS AT HIGH SOIL WATER CONTENTS,
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia).
N. C. Turner, E.-D. Schulze, and T. Gollan.
Oecologia, Vol. 63, No. 3, p 338-342. August, 1984. 5 Fig, 1 Tab, 17 Ref.

Descriptors: *Transpiration, *Leaf water potential, *Leaf gas exchange, Water potential, Conductance, Vapor pressure, Photosynthesis, Soil water.

Using well watered plants of the herbaceous species and members of the woody species having either sclerophyllous leaves or mesomorphic leaves, the responses of photosynthesis, transpiration and leaf conductance to changes in vapor pressure deficit were followed. Leaf conductance and net photosynthetic rate of the leaf decreased in all species when the vapor presssure deficit of the air around a single leaf in a cuvette was varied from 10 to 30 k/Pa in 5 Pa k/Pa steps. Transpiration rate increased initially with increase in vapor pressure deficit in all species, but in several species a maximum transpiration rate was noted at 20 to 25 Pa k/Pa. An increase in the vapor pressure deficit decreased leaf water potential in all species, being greatest in woody species and least in herbaceous species. Increasing the external vapor presssure deficit lowered the water potential of the leaf in the cuvette in the woody species and induced a decrease in leaf conductance in some, but not all, species. At least in the woody species studies, an increase in the vapor pressure deficit around a leaf will decrease leaf gas exchange through a direct effect on the leaf epidermis and sometimes additionally through a lowering of the mesophyll water potential. (Baker-IVI)
W85-02561

2E. Streamflow and Runoff

PERTURBATION SOLUTION FOR DAM-BREAK FLOODS,
Canterbury Univ., Christchurch (New Zealand). Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W85-02264

TWO-DIMENSIONAL FLOOD ROUTING ON STEEP SLOPES,
Post, Buckley, Schuh and Jernigan, Inc., Tampa, FL.
For primary bibliographic entry see Field 6F.
W85-02267

ZONATION OF MOSSES AND LICHENS ALONG THE SALMON RIVER IN IDAHO,
Montana Univ., Missoula. Dept. of Botany.
R. Rosentreter.
Northwest Science, Vol. 58, No. 2, p 108-117, May, 1984. 4 Fig, 1 Tab, 19 Ref, 1 Append.

Descriptors: *Salmon River, *Idaho, *Mosses, *Lichens, *Zonation, *River flow, Ecological distribution, High flow, Channel capacity, Substrate stability, Flood levels, Species composition.

The Salmon River in Idaho is the largest river in the western United States that does not have regulatory dams. Zonation of mosses and lichens occurs on both granite and basalt along the course of the river. Communities of mosses and lichens below high water mark form distinct associations. These zones may be as much as several meters in depth. Based on the species present and on fluctuating water levels, four zones were found. Results from paired transects indicate that stability of the substrate, force of the current, and distance above the low water level determine species dominance. Compared to the headwaters, the lowest reaches of the river have more favorable conditions for growth of mosses and lichens and for development of zonation patterns. The moss 'Barbula'-high flood zone could be used as an indicator of channel capacity and of high flood level at ungaged sites. At any given site and date, the water level could be compared to the vegetational zones, thereby evaluating the flood state. The frequency of high flood that determines the Barbula-high flood zone could, in the future, be calculated by correlating the Barbula level to flood levels at a gauged site. Species composition at any given site could give indication of the stability of that substrate and the force of the current at that site. (Collier-IVI)
W85-02330

NUMERICAL MODELLING OF A STEADY STATE FLOW IN A FREE SURFACE LOOPED HYDRAULIC NETWORK UNDER FLUVIAL CONDITIONS (MODELISATION NUMERIQUE D'UN ECOULEMENT PERMANENT DANS UN RESEAU HYDRAULIQUE MAILLE A SURFACE LIBRE, EN REGIME FLUVIAL),
J.-P. Baume, and M. Poirson.
Houille Blanche, No. 1/2, p 95-100, 1984. 5 Fig, 1 Tab, 6 Ref.

Descriptors: *Model studies, *Steady flow, Mathematical equations, Computers, Automation, Fluvial sediments.

The computerized calculation of steady state flow in free surface looped hydraulic networks is assisted by an iterative method which is based on the solution of a system of linearized equations. The sparse matrix of this system is broken up into blocks as opposed to investigating an overall solution. A special classification of equations and unknowns is employed and only discharges are found. This simplification saves both computer time and memory storage. (Baker-IVI)
W85-02353

ALTERATION OF STREAMFLOW CHARACTERISTICS FOLLOWING ROAD CONSTRUCTION IN NORTH CENTRAL IDAHO,
Intermountain Forest and Reange Experiment Station, Moscow, ID. Forestry Sciences Lab.
J. G. King, and L. C. Tennyson.
Water Resources Research, Vol. 20, No. 8, p 1159-1163, August, 1984. 1 Fig, 2 Tab, 11 Ref.

Descriptors: *Streamflow, *Idaho, *Forest management, *Access roads, *Road construction, Forest watersheds, Watersheds, Watershed management, Maximum flow, Minimum flow, Water yield.

Effects of logging access roads on seven streamflow variables were monitored on six forested headwater watersheds in north central Idaho. The streamflow variables were: annual maximum streamflow; date of maximum streamflow; annual minimum streamflow; annual water yield; and streamflow equaled or exceeded 5% of the year, 25% of the year, and 75% of the year. The watersheds, ranging in area from 28.3 to 147.7 ha, had less than 5% of their area in roads. Two statistically significant (alpha = 0.05) changes occurred following road construction: an increase in the 25% exceedance flows in one watershed and a decrease in the 5% exceedance flows in another watershed. No significant changes were detected in other flow parameters on any of the watersheds. The results indicate that the hydrologic behavior of small forested watersheds may be altered when only a small area is disturbed by roads. (Author's abstract)
W85-02372

CUT-THROAT FLUME CHARACTERISTICS,
Monash Univ., Clayton (Australia). Dept. of Civil Engineering.
For primary bibliographic entry see Field 7B.
W85-02453

INDICES OF FLOW ASYMMETRY IN NATURAL STREAMS: DEFINITION AND PERFORMANCE,
Sheffield Univ. (England). Dept. of Geography.
A. D. Knighton.
Journal of Hydrology, Vol. 73, No. 1/2, p 1-19, July, 1984. 6 Fig, 2 Tab, 18 Ref.

Descriptors: *River flow, *Flow asymmetry, *Streamflow, Meanders, Velocity, Mathematical equations, Fluid mechanics.

While asymmetric flow in streams is well known, particularly in the context of meandering, there is no formal quantitative definition of that asymmetry. Four indices are derived based on discharge differences between two sides of a flow cross section and velocity displacement relative to the channel centerline. The indices are assessed by comparing values for artificially-constructed flow cross-sections and by analyzing field data obtained as spatial series along two lengths of a gravel-bed stream, which involves both correlation and spectral analysis. In both respects one index stands out as providing the best overall measure of flow asymmetry. The asymmetry indices could provide a means of testing current hypotheses and of generating new ones, especially as regards relationships between flow pattern, the distribution of effective stresses and adjustment of channel form. Applications dealing with asymmetry variation along relatively short reaches or at the same station as discharge changes are probably the most tractable. Although potentially valuable, the analysis of flow asymmetry as a spatial series presents logistic difficulties when measurements need to be made at many sections at the same stage. (Baker-IVI)
W85-02456

TRIBUTARY DEVELOPMENT ALONG WINDING STREAMS AND VALLEYS,
State Univ. of New York at Buffalo. Dept. of Geography.
A. D. Abrahams.
American Journal of Science, Vol. 284, No. 7, p 863-892, September, 1984. 15 Fig, 4 Tab, 24 Ref.

Descriptors *Tributaries, *Streams, *Valleys, Geomorphology, Meanders, Channels, Valleys, Sinuosity.

Factors which control the formation of tributaries along winding streams and valleys are investigated. Emphasis is on winding streams and valleys, where the channel trace more or less coincides with the valley axis. The locations of tributaries along such streams are strongly influenced by the valley morphology while the position of the stream on the valley floor is irrelevant except where it is actively undercutting the valley side. The location of tributaries along manifestly underfit streams and streams meandering across the floors of meander trenches will be largely conditioned by the shape of each valley wall and will be essentially independent of the channel platform. Where the configurations of opposing valley walls are unrelated, tributary development on opposite sides of the stream will also be unrelated. Partial and multiple correlation analyses of 40 stream reaches indicate that 81% of the variation in the percentage of tributaries on the concave side of bends can be explained by the mean number of tributaries per bend, valley sinuosity, and the rate of bend migration. Seventy-two percent of the variation in the percentage of trans links can be accounted for by the percentage of tributaries on the concave side of bends, mean number of tributaries per bend, and valley sinuosity. The variable mean number of tributaries per bend represents both the availability of space on the convex of bends relative to that required for a tributary to form and the ratio of the mean bend length to mean chain length, which affects the convergence and divergence of runoff down valley sides. There is a tendency for cis links to form near bend apexes and trans links near bend inflections. The locations of tributaries along main streams can be understood largely in terms of the operation of four factors: the spatial requirements of tributaries, the sinuosity of the main valley, the lengths of the valley bends, and the rate of bend migration. Although an element of uncertainty that necessitates the use of stochastic models may be unavoidable in the study of channel networks, this element is much smaller than has hitherto been appreciated. (Baker-IVI)
W85-02469

MEANDERING-BRAIDED RIVER THRESHOLD: A REAPPRAISAL,
McGill Univ., Montreal (Quebec). Dept. of Geography.
M. A. Carson.
Journal of Hydrology, Vol. 73, No. 3/4, p 315-334, August, 1984. 8 Fig, 1 Tab, 33 Ref.

Descriptors: *Rivers, *Meanders, *Braided streams, Slopes, Bed load, Slope, Flow discharge, Sediments.

The concept of a threshold discharge slope combination that separates braided from meandering streams is critically re-examined. It is argued that discriminant functions that use mean annual discharge provide a poor physical basis for interpretations based on natural processes, while bankfull discharge is also deficient because it is not a fully independent variable. The common use of channel (rather than valley) slope adds a further misleading component because channel slope is partly dependent on channel pattern sinuosity. Two major points from this study are that the prerequisite for braiding is local shoaling of the thalweg (high relative width), and this is less dependent on a threshold hydraulic condition (for example stream power) than upon a threshold state of bed material transport, though often the two are related. Secondly, any hydraulic threshold will vary significantly with bed and bank material sediment, so that it is meaningless to seek a general threshold for all streams, unless those factors are considered. (Baker-IVI)
W85-02492

MODELS FOR NONLINEAR CATCHMENT ANALYSIS,
Technical Univ. of Istanbul (Turkey). Dept. of Hydraulics and Water Power.
R. F. Muftuoglu.
Journal of Hydrology, Vol. 73, No. 3/4, p 335-357. August, 1984. 4 Fig, 2 Tab, 15 Ref.

Descriptors: *Catchments, *Rainfall-runoff relationships, *Hydrograph analysis, *Model studies,

Precipitation, Water storage, Precipitation, Evaporation,.

Two nonlinear functional models which taken into account nonlinear storage and translation effects are developed for catchment analysis. The first model is a second-order superposition integral, of which the kernel function can be interpreted as the two-dimensional unit hydrograph, defined, in general, as a family of hydrographs, each member of which results from a unit of effective precipitation under the effect of antecedent unit effective precipitations. The second model, developed by modification of the first, is a functional series with linear and second-order functionals covering the delayed and immediate response periods, respectively. The results of the applications have indicated that the model represents catchment behavior with reasonable accuracy, even if evaporation is neglected. It is not much more complicated that the unit hydrograph model, and seems promising for practical applications. (Baker-IVI)
W85-02493

ECOLOGICAL TYPES OF RUNNING WATER BASED ON STREAM HYDRAULICS IN THE NETHERLANDS,
Rijksinstituut voor Natuurbeheer, Leersum (Netherlands).
L. W. G. Higler, and A. W. M. Mol.
Hydrobiological Bulletin, Vol. 18, No. 1, p 51-57, June, 1984. 4 Fig, 6 Ref.

Descriptors: *Streamflow, *Netherlands, *Hydraulics, *Ecology, Streams, Rivers, Water quality, Velocity, Manning's formula, *Surface-groundwater relations.

Except for the large rivers, all running waters in The Netherlands are fed by groundwater. The ground water level in its turn is fed by the precipitation surplus averaging some 200-400 mm/yr. This is the main climatological parameter determining the discharge of Dutch streams. The spatial and temporal characeristics of discharge areas directly influence the dimensions of streams of which the hydraulic radius is an important mean. Together with the slope of the terrain, this radius determines the stream velocity as indicated by the well-known formula of Manning. The factors determining life conditions in running waters can be arranged in a hierarchical scheme. One of the main factors is stream velocity. By transformation of Manning's formula a set of variables is acquired with which a diagram is constructed to contain all hydraulic conditions in running water. By measuring the ground slope and hydraulic radius at a certain station this station can be placed in the diagram. Data from Dutch streams and rivers form definite clusters enabling one to describe types of running waters on this basis. The distribution patterns of stream organisms in accordance with stream hydraulics can be fit into the diagram as well. (Baker-IVI)
W85-02504

STREAM ECOSYSTEMS IN MOUTAIN GRASSLAND (WEST CARPATHIANS); 2. HYDROLOGICAL CHARACTERISICS,
Institute for Land Reclamation and Grassland Farming, Wroclaw (Poland).
S. Kurek, and J. Pawlik-Dobrowolski.
Acta Hydrobiologica, Vol. 24, No. 4, p 307-320, 1982. 1 Fig, 6 Tab, 9 Ref.

Descriptors: *Land use, *Erosion, *Runoff, *Precipitation, *West Carpathians, *Poland, Evapotranspiration, Infiltration, Lithology, Catchment basins, Water balance.

Emphasis is placed on the runoff and agents affecting its spatial and time differentiation. The magnitude of runoff is one among several important factors causing changes in the chemical and biological relationships of the water environment. Data are collected from 20 years of study of precipitation and runoff. The variability of precipitation was affected by height above sea level and mezorelief, while that of runoff is influenced by varied precipitation, evapotranspiration, and varying conditions of infiltration due to differentiation of the lithology, tectonics, the kinds of soil, and the degree of forestation of the catchment basin. The greatest differences in runoff between particular catchment basins are to be observed in the case of extreme runoff and in the size of underground runoff. (Baker-IVI)
W85-02513

THROUGHFLOW INVESTIGATIONS IN 'VORDERER FINSTERTALER SEE' (TYROL) BY URANIN DYE (DURCHFLUSSUNTERSUCHUNGEN AM VORDEREN FINSTERTALER SEE (KUEHTAI, OSTERREICH) MIT URANINFAEBVERSUCHES),
G. Hadl, and M. Katzmann-Hambock.
Archiv fur Hydrobiologie, Vol 101, No 1/2, p 105-112, 1984. 4 Fig, 7 Ref.

Descriptors: *Streamflow, *Lakes, *Mixing, *Vorderer Finstertaler See, *Austria, Stratification, Velocity, Dye dispersion, Tracers, Dyes.

Data were sought which could be related to the inflow speed of water passing through the lake, Vorderer Finstertaler See. Uranin was used in the inflow and closely observed as the water carried the dye into the lake. Measurements demonstrated a body of water passing through the lake reaching down to 5 m below the surface, corresponding to the epilimnion. Uranin concentration was highest near the shore and gradually reduced toward the center of the lake. Only 10% of the total volume of the lake was affected by the inflow. At an average current velocity of about 5 cm per second, the point of outflow was reached after 5 hr. (Baker-IVI)
W85-02524

EPILITHIC AND EPIPELIC DIATOMS IN THE SANDUSKY RIVER, WITH EMPHASIS ON SPECIES DIVERSITY AND WATER POLLUTION,
Bowling Green State Univ., OH. Dept. of Biological Sciences.
R. J. Stevenson.
Hydrobiologia, Vol. 114, No. 3, p 161-175, July, 1984. 7 Fig, 3 Tab, 32 Ref.

Descriptors: *Species diversity, *Diatoms, *Rivers, *Sandusky River, *Ohio, *Water pollution effects, Seasonal variation, Water quality, Population dynamics.

Benthic diatom communities were collected seasonally from silty and rocky substrates to survey the water quality of the Sandusky River. Benthic diatom communities on natural substrates were sampled at 10 stations along a 180 km stretch of the river into which treated sewage is loaded at three sites. Species composition of diatom communities was commonly highly variable along the river, but recurrent changes in relative abundances of specific diatom species and over all community composition did indicate where loading of treated sewage affected water quality in the Sandusky River. Species diversity of diatom communities increased and decreased in response to impacts of treated sewage. (Baker-IVI)
W85-02545

PRIMARY PRODUCTION IN RATTLESNAKE SPRINGS, A COLD DESERT SPRING-STREAM,
Battelle Pacific Northwest Labs., Richland, WA. Environmental Sciences Dept.
C. E. Cushing, and E. G. Wolf.
Hydrobiologia, Vol. 114, No. 3, p 229-236, July, 1984. 6 Fig, 4 Tab, 32 Ref. AEC contract AT(45-1)-1830.

Descriptors: *Primary productivity, *Respiration, *Rattlesnake Springs, *Washington, Deserts, Ecosystems, Springs, Desert streams.

Data for annual community metabolism for several streams situated in either true deserts (Sycamore, Pinto, and Deep Creeks, Rattlesnake Springs) or in open, arid regions (Oklahoma, Kansas) are tabulated. Both annual gross productivity and respiration of Rattlesnake Springs are within the reported ranges of these streams. Net daily metabolism in Rattlesnake Springs is positive and supports the argument that autotrophy is prevalent in low order, arid streams, but contrary to the general contention that low order streams are heterotrophic. It appears that streams in cold and hot deserts have several attributes in common, including dominance of autotrophic processes, flushing, or resetting, of the systems by flash-floods, but differ as to whether they are net importers or exporters of organic matter on an annual basis. (Baker-IVI)
W85-02547

SPATIAL VARIABILITY OF LOW FLOWS ACROSS A PORTION OF THE CENTRAL SOUTHERN ALPS, NEW ZEALAND,
Ministry of Works and Development, Christchurch (New Zealand). Water and Soil Div.
I. E. Whitehouse, M. J. McSaveney, and G. A. Horrell.
Journal of Hydrology, Vol. 22, No. 2, p 123-137, 1983. 6 Fig, 1 Tab, 7 Ref.

Descriptors: *Streamflow, *Southern Alps, *New Zealand, *Low flow, Mountain streams, Rakaia River, Hokitika River, Waitaha River, Mikonui River, Seasonal variation.

Flows were measured in 48 tributaries of the Rakaia, Hokitika, Waitaha and Mikonui Rivers on 21 March 1978 during a period of extreme summer low flow, and on 54 tributaries on 17 July 1979 during winter low flow. In tributaries of the Rakaia, Hokitika, Mikonui and Waitaha Rivers, specific discharge in extreme summer low flows varies approximately linearly with mean annual precipitation. Most of the variation in specific instantaneous discharge at low flow is explained by variation in estimated basin mean annual precipitation in a given empirical relationship. There are small but significant differences in the exponent and coefficient of the power law for tributaries east and west of the main divide. These differences probably result from different regional recession constants reflecting differences in regolith thickness, which controls catchment storage, east and west of the main divide. Specific discharge at summer low flow may be interpolated between points of measurement in the central Southern Alps with a standard error of about 10 to 30%. Winter low flows are not related to precipitation, basin altitude, or summer low flow and do not appear to be correlated with any known, easily measured basin parameter. Low flows of the western basins were typically 3 times those of eastern basin for the same average basin altitude. Winter and summer low flows are members of different populations and so should be treated separately in the prediction of extremes. (Baker-IVI)
W85-02556

SENSITIVITY OF FLOW MEASUREMENT TO STAGE ERRORS FOR NEW ZEALAND CATCHMENTS (NOTE),
Ministry of Works and Development, Wellington (New Zealand).
H. J. Freestone.
Journal of Hydrology, Vol. 22, No. 2, p 175-181, 1983. 2 Fig, 4 Tab, 2 Ref.

Descriptors: *Streamflow, *Measuring instruments, *New Zealand, Mathematical equations, Sensitivity, Catchments, Errors, Water level.

Records from fifty automatic water-level recording stations representative of stations presently in operation within New Zealand were studied to determine the effect of water-level reading precision on the accuracy of flow records. The influence of stage-reading precisions of + or - 1 mm, + or - 3 mm and + or - 10 mm on mean flow, median flow and the flow exceeded 95% of the time were tested. Basins most sensitive to stage measuring error were those which has small flows. Gains from the installation of weirs and flumes did not usually result in increased accuracy sufficient to offset the decreased sensitivity due to the smaller range of stage that occurrs with very small flows. Stations with catchment areas less than about 50 sq km show errors greater than 5% at conditions where flow exceeded 95% of the time for a water

level reading precision of + or - 3 mm. Although the 50 stations used are only 6% of the total network, their selection was designed so that the findings might be applied to the whole network. The findings indicate which stations in the rest of the network are likely to be most affected by stage measurement errors. Application of the method would take the form of investigating individual sites to calculate sensitivity at given flows. (Baker-IVI)
W85-02559

SEASONAL PHYSICAL, CHEMICAL AND ALGAL CHANGES IN FIVE RIVERS FLOWING THROUGH THE OIL SANDS REGION OF ALBERTA, CANADA,
Alberta Univ., Edmonton. Dept. of Botany.
S. E. D. Charlton, and M. Hickman.
Internationale Revue der Gesamten Hydrobiologie, Vol. 69, No. 3, p 297-332, 1984. 28 Fig, 3 Tab, 36 Ref.

Descriptors: *Rivers, *Alberta, *Seasonal variations, *Algal growth, Chemical analysis, Temperatures, Conductance, Calcium, Potassium, Sodium, Magnesium, Iron, Manganese, Sulfate, Nitrate, Chloride, Population dynamics.

Seasonal studies concentrating on physical and chemical parameters and the epilithic algal community were conducted at specific sites in five tributary rivers flowing through the oil sands region of northeastern Alberta, Canada into the Athabasca River. Water discharge proved to be most important in controlling the chemical status of the water with most parameters (except nitrate) being inversely related to discharge in a logarithmic manner. Seasonal fluctuations in algal species composition and numbers are also described and discussed in relationship to the physical and chemical changes. Physically disruptive forces (current velocity and discharge) appeared more important than dissolved nutrients in affecting the growth of algae populations. (Baker-IVI)
W85-02562

MODEL FOR FLOW IN MEANDERING STREAMS,
Washington Univ., Seattle.
J. D. Smith, and S. R. McLean.
Water Resources Research, Vol. 20, No. 9, p 1301-1315, September, 1984. 10 Fig, 13 Ref, 1 Append.
NSF grant ENG 7816977.

Descriptors: *Streamflow, *Tidal channels, *Stream erosion, *Sediment deposition, Meanders, Shear stress, Topography, Channels, Mathematical models, Bed slope.

Rivers and tidal channels in estuaries do not always follow straight paths; rather they often take on shapes characterized by sequences of smooth bends. Erosion and deposition patterns in streams and tidal channels are sensitive to spatial variations in boundary shear stress, which in turn, can be induced by the complex interplay between the flow and bed and bank topography. A method whereby variations in boundary shear stress can be calculated is presented for flows that are broad in relation to their depth and for which the bed slopes are small. The formal scheme employs a regular perturbation expansion around a zero-order state that includes vertically integrated, topographically induced convective accelerations. Use of a zero-order velocity field that includes these accelerative effects yields a model that is applicable to streams with typical bed slopes and channel curvatures, one that can be employed in the majority of situations of interest to geomorphologists, sedimentologists, and hydraulic engineers concerned with fluvial and estuarine systems. Specific flow characteristics can be related, at least qualititively, to particular external parameters in channels wiht typical topographic features. Externally induced variation in the complex interplay amoung important flow characteristics can substantially alter patterns of boundary shear stress in natural sediment-transporting systems; hence they can change the erosion-deposition patterns and result in adjustments toward new equilibrium states. (Moore-IVI)
W85-02671

2F. Groundwater

APPROXIMATE SOLUTION OF FRESH WATER-SALT WATER INTERFACE IN CONFINED AQUIFERS (IN JAPANESE),
Ehime Univ., Matsuyama (Japan). Dept. of Ocean Engineering.
T. Kakinuma, K. Inouchi, and Y. Dohgane.
Japanese Journal of Limnology, Vol. 45, No. 2, p 100-110, April, 1984. 2 Fig, 9 Ref.

Descriptors: *Saline-freshwater interfaces, *Confined aquifers, Interface, Mathematical analysis, Model studies, Physical properties, Viscosity, Aquifers.

A new method for solving the problem of the unsteady motion of the interface between fresh and salt waters in aquifers is presented, using the following three approximations: 1) The viscosity of salt water is equal to that of fresh water; 2) the compressibility of the granular skeleton of the medium and the compressibility of the fluid in the salt water region are equal to those in a fresh water region; 3) in the equation for the thickness of the salt water layer, the term containing the storage coefficient is ignored. The numerical solutions by the new method are compared with the ones obtained by solving directly basic equations. For the special case of non-pumping and one-dimension, an analytical solution is found. It is in good agreement with the numerical solution by Sa Da Costa and Wilson (Sa da Costa, A. A. G. and J. L. Wilson, 1979. Massachusetts Institute of Technology, Cambridge, p 1-245), and Lui et al (Lui, P. L.-F., A. H.-D. Cheng, J. A. Liggett, and J. H. Lee, 1981. Wat. Resour. Res., Vol. 17, p 1445-1452), and it is similar to the experimental result by Bear and Dagan (Baer, J. and G. Dagan, 1964. Proc. A.S.C.E., J. Hydraul. Div., Vol. 90, No. HY4, p 193-216). (Author's abstract)
W85-02252

REGIONAL UNSTEADY FRESH WATER-SALT WATER INTERFACE IN CONFINED AQUIFERS (IN JAPANESE),
Ehime Univ., Matsuyama (Japan). Dept. of Ocean Engineering.
T. Kakinuma, K. Inouchi, and Y. Dohgane.
Japanese Journal of Limnology, Vol. 45, No. 2, p 144-152, April, 1984. 11 Fig.

Descriptors: *Naka River, *Japan, *Saline-freshwater interface, *Confined aquifers, Finite element method, Chlorides, Estuarine environment.

The authors presented a new method, which will appear in this Journal, to solve the problem of the unsteady motion of the interface between fresh water and salt confined aquifers. In this study, the Galerkin-finite element method is used to simulate the two-dimensional movement of the interface in a confined aquifer in the estuary of the Naka River, Tokushima Prefecture. The distributions of the chloride concentration predicted with the numerical model were in satisfactory agreement with the results of field observation. (Authors abstract)
W85-02256

PREDICTING GROUND-WATER RESPONSE TO PRECIPITATION,
Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Civil Engineering.
D. A. Sangrey, K. O. Harrop-Williams, and J. A. Klaiber.
Journal of Geotechnical Engineering, Vol. 110, No. 7, p 957-975, July, 1984. 12 Fig, 1 Tab, 10 Ref.
USGS grant 9-6102-05813.

Descriptors: *Slope stability, *Dam failure, *Precipitation, Groundwater movement, Drainage, Aquifers, Water levels, Evapotranspiration, Model studies.

High ground-water levels are a principal cause of slope instability and of significance in other geotechnical engineering problems. A methodology has been developed for predicting the fluctuation of ground-water levels as a function of precipitation. The approximate method uses measured characteristics of the site or region and a short period of calibration from a well record. The linkage of precipitation to ground water fluctuation can be used in either deterministic or probabilistic methods. The new methodology has been tested by application in several different geological and climatological areas. Different evapotranspiration models can be used in the method. Certain evapotranspiration models work better under given conditions than others. The aquifer drainage time can be evaluated by iteration using ground water records. Values of the drainage time for a similar region are similar thus providing a basis for extending this methodology to regional studies. The required calibration period can be defined according to the reliability desired. This method can be applied in risk-oriented probabilistic studies. The predictability of ground water fluctuations with precipitation can exceed 90%. Extreme events also can be modeled with similar reliability if sufficient data area available. (Baker-IVI)
W85-02260

BOUSSINESQ'S EQUATION SOLUTIONS FOR SEMI-INFINITE AQUIFER,
National Technical Univ., Athens (Greece). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W85-02269

GROUND WATER REDOX REACTIONS: AN ANALYSIS OF EQUILIBRIUM STATE APPLIED TO EH MEASUREMENTS AND GEOCHEMICAL MODELING,
Colorado Univ. at Boulder. Dept. of Geological Sciences.
R. D. Lindberg, and D. D. Runnells.
Science, Vol. 225, p 925-927, August, 1984. 2 Fig, 1 Tab, 25 Ref.

Descriptors: *Groundwater, *Chemical analysis, *Geochemistry, *Oxidation reduction potential, Model studies, Water analysis.

Computer modeling of 611 high-quality analyses of normal ground waters from diverse geographic areas reveals that aqueous oxidation-reduction reactions are generally not at equilibrium. Multiple redox couples present in individual samples yield computed Nernstian Eh (redox potential) values spanning as much as 1000 millivolts. The computed Eh values do not agree with each other, nor do they agree with the single 'master' value measured in the field with a platinum electrode. Because of internal disequilibrium, the use of any measured Eh values as input to equilibrium hydrogeochemical computer models will generally yield misleading results for normal ground waters. (Author's abstract)
W85-02357

ANALYTICAL SOLUTION FOR THE EFFECTS OF ABSTRACTION FROM A MULTIPLE-LAYERED CONFINED AQUIFER WITH NO CROSS FLOW,
Institute of Hydrology, Wallingford (England).
R. S. Wikramaratna.
Water Resources Research, Vol. 20, No. 8, p 1067-1074, August, 1984. 3 Fig, 3 Tab, 6 Ref, 1 Append.

Descriptors: *Confined aquifers, *Model studies, *Abstraction, *Drawdown, *Cross flow, Multiple layered aquifers, Aquifers, Aquifer characteristics.

A new analytical solution was developed which describes the drawdown in and around a fully penetrating abstraction well in a two-layered confined aquifer with no cross flow. The solution accounts for storage of water within the well; it can thus be applied both to large- and small-diameter wells. It is in the form of an infinite real integral which gives the drawdown at any point in the aquifer at any given time. The solution could be used as the basis for a type curve method of determining aquifer parameters by using data from the well and from one or more observation piezometers in each of the aquifer layers. For a constant abstraction rate the solution for the aquifer response was simplified to give an expression for the drawdown in the well. For certain special cases

the two-layered solution reduces to an existing solution for the equivalent single-layered aquifer. (Collier-IVI)
W85-02363

FLOW TO A PARTIALLY PENETRATING WELL IN A DOUBLE-POROSITY RESERVOIR,
Princeton Univ., NJ. Dept. of Civil Engineering.
D. E. Dougherty, and D. K. Babu.
Water Resources Research, Vol. 20, No. 8, p 1116-1122, August, 1984. 6 Fig, 1 Tab, 20 Ref.

Descriptors: *Double-porosity, *Aquifers, *Groundwater movement, *Well hydraulics, Model studies, Laplace equation, Van Everdingen Model, Fracture permeability.

Analysis of flow in a fractured porous reservoir forms the basis for investigations of chemical and energy transport in such media. Numerical models are often employed to analyze these geohydrologic systems. In this paper a well hydraulics problem is solved using the Laplace transformation and the double-porosity concept. The transient solution is obtained by numerical inversion of the Laplace transform. Solutions to slug test problems indicate that the head response due to fracturing is distinct from the response due to partial penetration or skin effect. An alternative to the commonly used van Everdingen model of skin effect is given. No method for identifying fractured porous reservoir parameters from slug tests has been developed. The results of this paper may be applied to test numerical models of flow in fractured porous media. (Author's abstract)
W85-02367

BOUNDARY INTEGRAL SOLUTION TO SEAWATER INTRUSION INTO COASTAL AQUIFERS,
Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering.
A. E. Taigbenu, J. A. Liggett, and A. H.-D. Cheng.
Water Resources Research, Vol. 20, No. 8, p 1150-1158, August, 1984. 15 Fig, 20 Ref. NSF grant CEE-7902803.

Descriptors: *Saline water intrusion, *Coastal aquifers, *Boundary element analysis, *Boundary integral equation, Mathematical models, Groundwater movement, Saline-freshwater interfaces, Hydrogeology, Finite element method, Finite difference methods, Model studies.

A three-dimensional boundary element analysis of seawater intrusion into freshwater aquifers is slightly more complex than a two-dimensional finite element analysis or finite difference analysis. Frequently, if detailed solutions are required, the knowledge of underground geology and accuracy of physical characteristics of the aquifer are insufficient and a more sophisticated program is required. The boundary integral equation method (BIEM) was used to solve problems of seawater intrusion into a freshwater aquifer that is being pumped. The transient problem of intrusion (lens type) into a deep aquifer was solved, as was the steady state problem of intrusion (wedge type) into a shallow aquifer. The Dupuit-Forchheimer approximation reduces the three-dimensional problem to two dimensions and the Ghyben-Herzberg approximation simplifies the treatment of flow in the saltwater region. A 'special potential' eliminates the need to track explicitly the freshwater-saltwater interface. The numerical program adds to the capability of the general groundwater basin model, which was based on the same techniques. The BIEM represents savings in data preparation, computer storage, computer time, and data interpretation compared to finite difference and finite element models. (Collier-IVI)
W85-02371

THREE-DIMENSIONAL MODEL OF A SKIMMING WELL,
Sind Agriculture Univ., Tandojam (Pakistan). Dept. of Irrigation and Drainage.
B. A. Chandio, and B. E. Larock.
Journal of Irrigation and Drainage Engineering, Vol. 110, No. 3, p 275-288, September, 1984. 8 Fig, 12 Ref.

Descriptors: *Skimming, *Wells, *Model studies, Unconfined aquifers, Computers, Finite element method, Mathematical studies, Developing countries, Water supply development, Salinity.

Partially penetrating wells called skimming wells are one important tool that can be used to develop water supplies from sources where a thin layer of fresh water lies directly above a layer of saline water. A three-dimensional model of skimming well operation in a shallow, unconfined, fresh water layer is presented. Preliminary numerical experiments indicate that the transient growth of salinity toward the partially penetrating well has been correctly simulated with a miscible flow model in the relatively thin upper layer. Computer programing features are described that allow one to operate the program on a moderate-size computer, such as ones that private engineering organizations and the governments of developing countries may be able to use. The magnitudes of the changes in salinity as a function of well and aquifer geometry are significant. (Baker-IVI)
W85-02446

ISOTOPIC ANALYSES AND HYDROCHEMISTRY OF THE THERMAL SPRINGS ALONG THE EASTERN SIDE OF THE JORDAN DEAD SEA - WADI ARABA RIFT VALLEY,
Jordan Univ., Amman. Water Research and Study Center.
E. Salameh, and O. Rimawi.
Journal of Hydrology, Vol. 73, No. 1/2, p 129-145, July, 1984. 6 Fig, 3 Tab, 36 Ref.

Descriptors: *Thermal springs, *Jordan, *Wadi Araba, Water chemistry, Isotope studies, Precipitation chemistry, Groundwater, Rift valley, Geohydrology.

The isotopic composition of the present precipitation as well as the groundwaters of Jordan lies between the eastern Mediterranean and the meteoric water lines. Water precipitated on the mountainous area infiltrates the bedrock, flows in an easterly direction, through several aquifers, then flows westerly and discharges along the steep slopes of the Dead Sea escarpment. This flow and discharge is controlled mainly by the prominent geologic structures of the Jordan-Dead Sea Rift Valley. The dissolved solids of the waters are derived primarily from the Upper Cretaceous sediments covering the infiltration area. These waters mix with hypersaline water present in the Lower Cretaceous or older rocks. The amount of total dissolved solids increases with increasing temperatures. The elevated temperature of many spring waters is the result of deep circulation under the normal geothermal gradient. The isotopic composition of precipitation in Jordan lies between the eastern Mediterranean and the meteoric water lines. It differs from one storm to another and shows a distinct quantitative effect - the higher the rainfall the less enriched the isotopic composition. The groundwaters of the surface aquifers also lie between the eastern Mediterranean and the meteoric water lines. In southern Jordan, the isotopic composition is shifted closer to the meteoric line. The deep sandstone aquifer contains water mixed from two members, a major one infiltrating from the Tertiary-Upper Cretaceous aquifers of central Jordan and a minor one originating from the sandstone suface aquifers of southern Jordan. The latter flows northeast where it mixes with the major members south of the latitude of Azraq, turns gradually to the west and discharges along the slopes above the Dead Sea. (Baker-IVI)
W85-02462

FRESHWATER 'CENTRAL LENS' OF BERMUDA,
Bermuda Public Works Dept., Hamilton.
M. Rowe.
Journal of Hydrology, Vol. 73, No. 1/2, p 165-176, July, 1984. 6 Fig, 1 Tab, 22 Ref.

Descriptors: *Aquifer recharge, *Water table, *Bermuda, *Central Lens, *Water management, Water supply, Permeability, Geology, Groundwater recharge.

In the Central Lens area of Bermuda there are two major rock bodies and these belong to the Belmont and Paget Groups. They form adjacent parallel aquifers of greatly contrasting permeability. The older Belmont Limestone has undergone greater solutional alteration and is the more permeable. Under steady state conditions the Central Lens configuration supports the Ghyben-Herzberg theory. On a yearly average basis, the degree of disequilibrium is substantial. The water table is far more responsive to variations in recharge than is the interface. In relatively wet years the water table height above sea level can be 50% above that of dry years. Due to a vertical zonation of flow activity, the effect of an event at the water table only manifests itself at the interface after considerable dampening and lagging. A possible cause for this could be the development of a higher-permeability zone at the water table, but the presence or lack of such a feature, which has been observed in other environments, has yet to be proved in Bermuda. On less than a yearly average basis the water table levels are dominated by the influence of sea level, which cannot be readily removed and therefore presents a major obstacle to short term studies. Demonstration of a relatively stable lens thickness, below sea level, allows a less cautious approach to management of pumping rates than had been previously taken. A maximum permissible thinning of the lens is considered as 45% in fresh areas and 60% in brackish areas. Under these conditions it is calculated that about 75% of recharge could be abstracted. (Baker-IVI)
W85-02464

SIMPLIFIED GRAPHICAL SOLUTION OF THE THEIS EQUATION,
Victoria State Rivers and Water Supply Commission, Tatura (Australia).
For primary bibliographic entry see Field 4B.
W85-02465

NONEQUILIBRIUM AND EQUILIBRIUM SORPTION WITH A LINEAR SORPTION ISOTHERM DURING MASS TRANSPORT THROUGH AN INFINITE POROUS MEDIUM: SOME ANALYTICAL SOLUTIONS,
California Univ., Berkeley. Lawrence Berkeley Lab.
C. L. Carnahan, and J. S. Remer.
Journal of Hydrology, Vol. 73, No. 3/4, p 227-258, August, 1984. 1 Fig, 28 Ref. 3 Append. DOE contract DE-AC03-76SF00098.

Descriptors: *Solute transport, *Groundwater flow, *Isotherms, Porosity, Mathematical equations, Mass transfer, Path of pollutants.

Analytical solutions have been developed for the three-dimensional axisymmetric problem of solute transport in a steady field of groundwater flow with nonequilibrium mass transfer of a radioactive species between fluid and solid phases, and with unequal longitudinal and lateral hydrodynamic dispersion. Interphase mass transfer is described by a first-order rate expression. Solutions are presented also for the case of equilibrium distribution of solute between fluid and solid phases. Three types of release from a point source were considered: instantaneous release of a finite mass of solute, continuous release at an exponentially decaying rate, and release for a finite period of time. Computational results for point-source solutions show the expected variation of sorptive retardation effects progressing from the case of no sorption, through cases of nonequilibrium sorption, to the case of equilibrium sorption. The point-source solutions serve as standards for checking, and comparison with, numerical models with second-order rate laws for sorption, now being studied. The point- and line-source solutions are useful approximations, in the far field, to solutions of linear transport problems involving source functions for which a total rate of release of sorbate can be specified. The point-source solutions are directly applicable to the development of analytical solu-

tions of problems involving source functions occupying finite regions of the space in which transport takes place. (Baker-IVI)
W85-02488

STRESSES AND DISPLACEMENTS IN AN AQUIFER DUE TO SEEPAGE FORCES (ONE-DIMENSIONAL CASE),
Universidad Nacional Autonoma de Mexico, Mexico City. Facultad de Ingenieria.
E. Juarez-Badillo, and G. E. Figueroa-Vega.
Journal of Hydrology, Vol. 73, No. 3/4, p 259-288, August, 1984. 10 Fig, 2 Tab, 16 Ref.

Descriptors: *Aquifers, *Groundwater movement, *Subsidence, *Seepage loss, *Stress, Cracks, Drainage, Mathematical studies, Pumping.

The extraction of water from aquifers by pumping produces settlement and cracking in the subsoil. Settlement due to pumping is fairly well understood, but cracking had no appropriate theories to explain it. Seepage-force-induced cracks are analyzed in an aquifer divided by a well line which is approximated by a line drain. Mathematical expressions for the stresses and displacements in the aquifer due to seepage forces for the steady and unsteady one-dimensional cases are presented. The aquifer is assumed to be constituted by a linearly elastic material. The study showed that stress and displacements in an aquifer may be estimated considering some ideal cases and their asymptotic solutions. An important ideal case is when the rigidities of the confining strata are very high compared to the ridigity of the aquifer. For this ideal case there exists a critical volume rate of flow which should not be surpassed if sliding of the aquifer towards the well line is to be avoided. (Baker-IVI)
W85-02489

INFLUENCE OF SEEPAGE ON THE DEPTH OF WATER TABLES IN DRAINAGE,
Instituut voor Cultuurtechniek en Waterhuishouding, Wageningen (Netherlands).
For primary bibliographic entry see Field 4B.
W85-02490

SPACE-TIME FINITE-ELEMENT MODEL FOR TWO-STREAM UNCONFINED AQUIFER SYSTEMS,
Chile Univ., Santiago. Centre de Recursos Hidraulicos.
G. Cabrera, and G. Matthey.
Journal of Hydrology, Vol. 73, No. 3/4, p 239-314, August, 1984. 10 Fig, 2 Tab, 15 Ref.

Descriptors: *Finite element method, *Model studies, *Aquifers, Unconfined aquifers, Water levels, Infiltration, Computers.

A finite-element model has been developed to represent water-table fluctuations in a two-stream unconfined aquifer system due to recharge from infiltration. Linear approximation functions of space and time within elements, the Galerkin residual method and the Newton-Raphson method of solution for the resultant nonlinear system of equations were used. The model has shown good agreement with available analytical solutions and gives reasonably good results when applied to other cases such as variable infiltration, evaporation, and flood waves in the streams. Computer times involved, however, as compared with a finite-element finite-difference model, are at least twice as long, depending on the time-domain size. Approximations to the analytical solutions are similar in all cases. A better approach to the problem would be to take finite elements with higher-order approximation functions in space and finite differences in time, in order to represent more adequately, for example, zones of high hydraulic gradients, and to obtain shorter computer times. (Baker-IVI)
W85-02491

BUOYANT CONTAMINANT PLUMES IN GROUNDWATER,
Harza Engineering Co., Chicago, IL.
For primary bibliographic entry see Field 5B.
W85-02660

EFFECT OF TORTUOSITY ON FLUID FLOW THROUGH A SINGLE FRACTURE,
California Univ., Berkeley. Lawrence Berkeley Lab.
Y. W. Tsang.
Water Resources Research, Vol. 20, No. 9, p 1209-1215, September, 1984. 7 Fig, 2 Tab, 20 Ref. DOE contract DE-AC03-76SF00098.

Descriptors: *Tortuosity, *Fluid flow, *Geologic fractures, Groundwater movement, Connectivity, Flow rate, Mathematical studies, Apertures, Geothermal energy.

The movement of fluids through fractures in very low permeability rock is important in many areas of practical interest, such as the isolation of hazardous wastes in geological structures, the recovery of fossil fuels, and the development of geothermal energy. Mathematical modeling of flow through a fractured medium invariably requires the assumption of a physical law which governs the fluid movement through one single fracture. The effects of path tortuosity and connectivity on fluid flow rate through a single rough fracture were studied. The flow paths are represented by electrical resistors placed on a two-dimensional grid, and the resistances vary as the inverse of the fracture aperture cubed. The electric current through the circuit bears a one-to-one correspondence to the fluid flow rate. Both fracture apertures derived from measurements and from hypothetical analytic functions were used in a parameter study to investigate the dependence of tortuosity on fracture roughness characteristics. The more small apertures there are in the aperture distribution, the larger is the effect of tortuosity. When the fraction of contact area between the fracture surfaces rises above 30%, the aperture distributions are invariably large at small apertures, and the effect of fracture roughness and flow path tortuosity depresses flow rate from the value predicted by the parallel plate representation of a fracture by three or more orders of magnitude. Since the fraction of contact area of the rough fracture is the contrlling factor to determine the magnitude of the effect of tortuosity, the question of whether tortuosity is important or not in flow through real fractures points to the question of how the fractional contact area of a fracture varies as a function of stress. (Moore-IVI)
W85-02662

FLOW TOWARD STORAGE TUNNELS BENEATH A WATER TABLE; 2. THREE-DIMENSIONAL FLOW,
Tel-Aviv Univ. (Israel). Faculty of Engineering.
For primary bibliographic entry see Field 4B.
W85-02663

SCALES FOR DOUBLE-DIFFUSIVE FINGERING IN POROUS MEDIA,
Wisconsin Univ.-Madison. Dept. of Civil and Environmental Engineering.
T. Green.
Water Resources Research, Vol. 20, No. 9, p 1225-1229, September, 1984. 2 Fig, 13 Ref.

Descriptors: *Diffusion, *Porous media, *Double-diffusive fingering, Groundwater movement, Mathematical models.

The influence of the double-diffusive process of fingering on vertical transport in a porous medium is examined, using a very successful model borrowed from oceanic salt finger theory. The results suggest that fluxes associated with double-diffusive fingering may well be important, at least in regions where the porous medium is saturated. The effect of horizontal dispersion remains to be accounted for and will probably place limits on the efficiency of the process. (Author's abstract)
W85-02664

ANALYSIS OF THE INFLUENCE OF FRACTURE GEOMETRY ON MASS TRANSPORT IN FRACTURED MEDIA,
British Columbia Univ., Vancouver. Dept. of Geological Sciences.
L. Smith, and F. W. Schwartz.
Water Resources Research, Vol. 20, No. 9, p 1241-1252, September, 1984. 10 Fig, 6 Tab, 9 Ref.

Descriptors: *Geologic fractures, *Fracture geometry, *Mass transport, Stochastic process, Model studies, Fracture aperture, Connectivity, Dispersion.

A stochastic modeling technique has been developed to investigate mass transport within a network of discrete fractures. The fracture network is composed of two orthogonal fracture sets, with fracture length, location, and aperture characterized by appropriate probability distributions. Emphasis is placed on understanding how fracture geometry influences mass transport within a network of discontinuous fractures. The network is aligned in such a manner that one fracture set (set one) forms the dominant pathway for transport. The primary role of the second fracture set is to provide connecting pathways between the discontinuous fractures of set one. Results suggest that mass transport can be described in terms of directness of the connection between the upstream and downstream boundaries. Variations in fracture geometry which have the effect of increasing the probability that a relatively indirect or circuitous pathway exists through the network generally lead to an increase in both the mean and the standard deviation in the arrival time of various breakthrough fractions. Examples include a reduction in the number of fractures forming the set aligned with the direction of the hydraulic gradient or a decrease in the average length of fractures forming that set. Variations in fracture geometry which have the effect of increasing the probability that a relatively direct pathway will exist through the network have the opposite effect. Transport is sensitive to the variability in fracture aperture. The connectivity of the fracture network is also shown to influence the magnitude of dispersive effects. (Author's abstract)
W85-02666

DISPERSION OF TRACE SOLUTES IN FLOWING GROUNDWATER,
Wisconsin Univ.-Madison. Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5B.
W85-02667

LINEARIZATION TECHNIQUES AND SURFACE OPERATORS IN THE THEORY OF UNCONFINED AQUIFERS,
Oregon State Univ., Corvallis.
G. Bodvarsson.
Water Resources Research, Vol. 20, No. 9, p 1271-1276, September, 1984. 2 Fig, 8 Ref. NSF grant EAR 8023850.

Descriptors: *Aquifers, *Mathematical equations, *Groundwater movement, *Linearization, Free surface, Fluid flow, Differential equations.

The theory of Darcy type fluid flow in unconfined homogenous aquifers is of considerable importance in the modeling of many hydrological and geothermal systems. In the case of slow, small free surface displacement amplitudes, it is possible to linearize the free surface condition and depend on rather simple analytical and numerical methods to solve the flow equations governing such models. Defining a new type of cross-surface differential operators, the linearized free surface condition on the boundary surface can be interpreted as a new type of partial differential equation. For the linearization procedure to be applicable, there is an upper limit to the total liquid withdrawal that can take place during any fixed period of time. It has not been possible to provide a simple expression for the criterion, and the condition will have to be used on a trial basis. (Moore-IVI)
W85-02669

BOREHOLE METHODOLOGY FOR HYDROGEOCHEMICAL INVESTIGATIONS IN FRACTURED ROCK,
National Hydrology Research Inst., Ottawa (Ontario).
For primary bibliographic entry see Field 7B.
W85-02670

ANISOTROPY IN THE IRONTON AND GALESVILLE SANDSTONES NEAR A THERMAL-ENERGY-STORAGE WELL, ST. PAUL, MINNESOTA,
Geological Survey, St. Paul, MN.
R. T. Miller.
Ground Water, Vol. 22, No. 5, p 532-537, September-October, 1984. 5 Fig, 3 Tab, 5 Ref. DOE contract DE-AC06-76RLO 1830 subcontract B-97601-A-C.

Descriptors: *Anisotropy, *Thermal energy storage, *St. Paul, *Minnesota, Injection wells, Aquifers, Transmissivity, Storage coefficient.

The U.S. Geological Survey is studying the potential for storage of heated water in a sandstone aquifer in St. Paul, Minnesota. The efficiency of the aquifer to the store thermal energy is related, in part, to the hydrogeologic characteristics of the aquifer. The movement of heat away from the injection well is directly related to the anisotropy. Aquifer tests were conducted to determine the anisotropy near the heated-water injection well. The maximum and minimum values of transmissivity along the principal directions of the hydraulic conductivity tensors of the Ironton and Galesville Sandstones in St. Paul, Minnesota are approximately 1,090 and 480 feet squared per day. The storage coefficient is 0.000045. These values represent the average of four determinations of nonsteady flow to a well in an idealized infinite anisotropic aquifer. Analysis of the values of transmissivity and storage coefficient for hypothetical changes in location of two of the monitoring wells where depth-deviation surveys were not available indicates that computed transmissivities vary less than +/- 5% and storage coefficients vary less than +/- 6%. (Author's abstract)
W85-02684

AQUIFER STUDIES USING FLOW SIMULATIONS,
Binnie and Partners, London (England).
S. Puri.
Ground Water, Vol. 22, No. 5, p 538-543, September-October 1984. 8 Fig, 2 Tab, 6 Ref.

Descriptors: *Simulation, *Groundwater movement, *Lower Greensand, *England, Water level, Groundwater recession, Groundwater recharge, Drawdown, Hydrologic budget, Baseflow.

Flow simulations were used to supplement a hydrogeological study of the Lower Cretaceous, partly consolidated orthoquartzite known as the Lower Greensand. In southern England the Lower Greensand is an important source of water supply. The lack of aquifer monitoring prior to the 1970's gave rise to an uncertainty as to whether present-day water levels were declining. Simulation studies were carried out to refine the annual recharge estimate, to define the past effects of pumping and to obtain and indication of future trends. Catchment water balance indicates average annual recharge of 28 x 10 to the 6th cu m. The present overall abstraction from the aquifer is 71% of the annual recharge. The original 'natural' baseflow has reduced from 72% of annual recharge to the present 29%. The rate of water-level decline was high soon after the start of pumping and was over 0.3 m/yr for 55 years in the outcrop area. In the confined area, this rate occur for 70 yr. Following these periods the levels decline at a progressively lower rate, until a new steady state is reached. Pumping at distances as far as 30 km from the outcrop cause small but measurable drawdowns. (Moore-IVI)
W85-02685

FIELD TESTING THE HYPOTHESIS OF DARCIAN FLOW THROUGH A CARBONATE AQUIFER,
Geological Survey, Tampa, FL.
For primary bibliographic entry see Field 4B.
W85-02686

SIMULATION OF GROUND-WATER FLOW IN A MINED WATERSHED IN EASTERN OHIO,
Geological Survey, Columbus, OH.
For primary bibliographic entry see Field 4C.
W85-02687

RESULTS OF SEEPAGE METER AND MINI-PIEZOMETER STUDY, LAKE MEAD, NEVADA,
Montana Univ., Missoula. Dept. of Geology.
For primary bibliographic entry see Field 2H.
W85-02688

WEIGHTING OF OBSERVED HEADS FOR THE INVERSE PROBLEM,
Disposal Safety, Inc., Washington, DC.
B. Ross.
Ground Water, Vol. 22, No. 5, p 569-572, September-October, 1984. 2 Fig, 1 Tab, 7 Ref.

Descriptors: *Hydraulic head, *Estimation, Hydraulic gradient, Transmissivity, Groundwater recharge, Groundwater discharge, Hydrogeology.

In numerical methods for estimating transmissivities, recharges, discharges, and boundary fluxes from observed data, the hydrogeological parameters are estimated by finding the values which, when used to calculate heads, best match the observed heads. In using least-squares parameter estimation techniques to solve for hydrogeologic parameters, a weighting function may be used to reflect differing reliabilities of head measurements. In previous studies, the weighting function has been used in an ad hoc manner or not at all. The inverse square of the observed hydraulic gradient, adjusted to reflect the modeler's perception of geologic heterogeneity and data reliability, is typically an appropriate wieghting function. A slightly more complex formula may be used when measurement uncertainty is important. (Moore-IVI)
W85-02689

OPTIMAL SPACING OF INTERFERING WELLS: AN ANALYTIC SOLUTION,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 4B.
W85-02690

DETECTION OF AN IMPERMEABLE BOUNDARY IN AN ANISOTROPIC FORMATION: A CASE STUDY,
In-Situ, Inc., Laramie, WY.
S. C. Way, and C. R. McKee.
Ground Water, Vol. 22, No. 5, p 579-583, September-October, 1984. 5 Fig, 2 Tab, 2 Ref.

Descriptors: *Anisotropy, *Impermeable boundaries, *Image-well theory, Boundaries, Transmissivity, Groundwater movement, Mathematical equations.

Image-well theory is well known as a way to locate hydrologic boundaries in isotropic formations from pump test data, but it does not directly apply in anisotropic formations because the relationship between flow lines and equipotential lines is distorted due to directional transmissivity. A simple approach to locate an impermeable boundary in anisotropic formations is developed using the method of images. Information on directional transmissivity is essential in applying the theory, and knowledge of groundwater flow will, in many cases, help verify the findings. (Moore-IVI)
W85-02691

MODELING ORGANIC CONTAMINANT PARTITIONING IN GROUND-WATER SYSTEMS,
Michigan Univ., Ann Arbor.
For primary bibliographic entry see Field 5B.
W85-02692

MIGRATION OF CHLOROPHENOLIC COMPOUNDS AT THE CHEMICAL WASTE DISPOSAL SITE AT ALKALI LAKE, OREGON - 1. SITE DESCRIPTION AND GROUND-WATER FLOW,
Oregon Graduate Center, Beaverton.
For primary bibliographic entry see Field 5B.
W85-02693

NUMERICAL METHOD OF PUMPING TEST ANALYSIS USING MICROCOMPUTERS,
Birmingham Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 4B.
W85-02694

SIMPLE ANALYTICAL SOLUTIONS FOR THE HP41CV PROGRAMMABLE CALCULATOR,
Kleinfelder (J.H.) and Associates, Fresno, CA.
For primary bibliographic entry see Field 4B.
W85-02695

2G. Water In Soils

MACROPOROSITY TO CHARACTERIZE SPATIAL VARIABILITY OF HYDRAULIC CONDUCTIVITY AND EFFECTS OF LAND MANAGEMENT,
Hawaii Univ., Honolulu.
L. R. Ahuja, J. W. Naney, R. E. Green, and D. R. Nielsen.
Soil Science Society of America Journal, Vol. 48, No. 4, p 699-702, July-August, 1984. 7 Fig, 17 Ref.

Descriptors: *Soil porosity, *Permeability coefficient, *Land management, *Macroporosity, Mollisols, Oxisols, Tillage effects, Effective porosity, Porous media, Porosity.

To develop simplified methods of hydraulic characterization of field soils and effects of management, frequency distribution of macroporosity (or effective porosity) in a soil was investigated as a measure of its saturated hydraulic conductivity distribution. The effective porosity (phi sub c) of a soil is related to its saturated hydraulic conductivity (K sub s) by a generalized Kozeny-Carman equation. The exponent of this relationship was assumed to vary within a narrow range (value of 4 or 5). The equation was then combined with scaling theory to derive the frequency distribution of K sub s scaling factors from the phi sub c distribution. These concepts were tested on experimental data for two widely different soils, a mollisol and an oxisol. The phi sub c is defined as total porosity minus soil water content at -33 kPa pressure head. The exponent of the ((K sub s) - (phi sub c)) relationship was found to be nearly 4 for the soil-core data of both soils, while for a smaller set of in-situ field data for oxisol, which was within a narrow range of phi sub c, the value of the exponent was smaller. There was a considerable scatter in the relationships. However, with the exponent set equal to 4 or 5 the distribution of K sub s scaling factors derived from phi sub c distribution closely matched the experimental K sub s derived distribution. The approach has a promise for large-scale applications. (Author's abstract)
W85-02317

STEADY INFILTRATION FROM SPHERICAL CAVITIES,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Environmental Mechanics.
J. R. Philip.
Soil Science Society of America Journal, Vol. 48, p 724-729, 1984. 6 Fig, 1 Tab, 9 Ref.

Descriptors: *Spherical cavities, *Infiltration, *Capillarity, Soil water, Unsaturated flow, Subirrigation, Flow, Moisture potential.

The problem of quasilinearized steady infiltration from spherical cavities, with the moisture potential fixed at the cavity surface, is solved exactly. Solutions are presented numerically and graphically for values of the dimensionless cavity radius R sub 0 in the range 0 to 10. The dependence of R sub 0 of total cavity flow, of the variation of infiltration rate around the cavity surface, and of the distributions of moisture content and potential, are examined. As R sub 0 increases, gravity increasingly distorts the moisture distribution from the symmetry produced by capillarity alone. This distortion, although marked, is less than one-hundredth that for infiltration from circular cylindrical cavities: a vivid illustration of the stronger dominance of

gravity over capillarity in two-dimensional systems than in three-dimensional ones. An earlier approximate solution of this problem proves accurate only for R sub 0 < or = 0.27. The cavity flow, evaluated by the present analysis, may be combined with the point source solution to give approximate results useful for the region deeper than 20 radii below the cavity. (Author's abstract)
W85-02318

EVALUATION OF SIMPLIFIED METHODS FOR DETERMINING UNSATURATED HYDRAULIC CONDUCTIVITY OF LAYERED SOILS,
Minnesota Univ., St. Paul. Dept. of Soil Science.
W. M. Schuh, J. W. Bauder, and S. C. Gupta.
Soil Science Society of America Journal, Vol. 48, p 730-736, 1984. 2 Fig, 1 Tab, 21 Ref.

Descriptors: *Permeability coefficient, *Layered soils, *Soil water, Conductivity, Permeability, Hydraulic head, Matric suction, Matric potential, Soil water potential.

The simplified field method of L.R. Ahuja et al. (Ahuja, L.R., R.E. Green, S.K. Chong, and D.R. Nielson. 1980. Water Resour. Res. Vol. 16, p 947-953) for determining hydraulic conductivity as a function of soil water suction, K(S), and the simplified field method of P.L. Libardi et al. (Libardi, P.L., K. Reichardt, D.R. Nielson, and J.W. Biggar. 1980. Soil Sci. Soc. Am. J. Vol. 44, p 3-7) for determining hydraulic conductivity as a function of soil water content, K(theta), were compared with the instantaneous profile method, to evaluate their suitability for estimating hydraulic conductivity of layered soil. The Ahuja method worked well on coarse and fine-textured soils and complex soil profiles with stratification. The Libardi method worked well on coarse and fine-textured, homogeneous materials and homogeneous parent materials underlying stratified soil materials. A calculated matching K value (K sub 0) was used with the Libardi method. Within layered soil materials slopes of the K(theta) curves, calculated with the Libardi method, were adequate; however, calculated K sub 0 values were often inadequate. Fit of calculated values with measured values of hydraulic conductivity could have been improved by using field-determined K sub 0 values. (Author's abstract)
W85-02319

HYDRAULIC CONDUCTIVITY AND WATER RETENTION OF CLAY SOILS CONTAINING COARSE FRAGMENTS,
Technion - Israel Inst. of Tech., Haifa. Dept. of Agricultural Engineering.
I. Ravina, and J. Magier.
Soil Science Society of America Journal, Vol. 48, p 736-740, 1984. 5 Fig, 2 Tab, 9 Ref.

Descriptors: *Permeability coefficient, *Water retention, *Clay soils, *Stoney soils, Gravel, Porosity, Soil compaction, Compaction, Soil water suction.

Field observations show that clay soils with medium to high coarse fragment contents are less compacted, have more favorable structure and provide better physical condition for tree growth than similar soils containing small amounts of coarse fragments. The effect of coarse fragments on soil compaction, hydraulic conductivity, and moisture retention at low suctions was investigated. Increasing coarse fragment content increased resistance to compaction and consequently preserved lower soil bulk density. Larger volumes of large pores were found after compaction of soil with increasing coarse fragment content. In compacted soils of increasing coarse fragment content, hydraulic conductivity was higher. Aerated porosity of soils between fragments increased with fragment content. It was concluded that coarse fragments contribute to improved physical conditions by acting as a 'skeleton' which resists soil compaction. (Author's abstract)
W85-02320

NONUNIFORM LEACHING FROM NONUNIFORM STEADY INFILTRATION,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Environmental Mechanics.
J. R. Philip.
Soil Science Society of America Journal, Vol. 48, p 740-749, 1984. 11 Fig, 13 Ref.

Descriptors: *Leaching, *Infiltration, *Unsaturated flow, Moisture potential, Flow, Isochrones, Soil texture, Percolation.

The two-dimensional quasilinear steady flow equation is solved exactly for arbitrary periodic distribution of surface source strength nu sub 0 (x) (x, horizontal coordinate), both for flow to infinite depth and to a water table at finite depth. Solutions are given both for the Kirchhoff variable Theta and the stream function phi. They are explored in detail for nu sub 0 = (mean nu sub 0)(1 + eta cos(pi x/l)) (0 < eta < or = 1). For each solution emphasis is placed on determining the limits on nu sub 0 (x) which ensure that the moisture potential Psi < or = 0, so that the quasilinear formulation is applicable. This essential precaution has sometimes been disregarded. The presence of water table strongly influences Theta, but has relatively little effect on phi. This makes possible important mathematical simplifications. Remarkably, simple exact solutions are found for travel times. They reveal singularities in the travel-time functions overlooked in previous work using a finite difference method. For large times, the family of isochrones behaves like a traveling wave with the shape and velocity constant. Streamlines and isochrones are compared for a coarse soil (parameter alpha = 25/m) and a fine one (alpha = 0.25/m). Surface velocity differentials persist much more strongly for the coarse soil, which exhibits much greater horizontal variation of travel times. By one measure, nonuniformity of leaching is 7.8 times greater in the coarse soil than the fine one. A previous study of problems of this class concluded incorrectly that leaching is more uniform for saturated than for unsaturated flow. (Author's abstract)
W85-02321

LINEAR ANALYSIS OF THERMAL EFFECTS ON EVAPORATION FROM SOIL,
Princeton Univ., NJ. Dept. of Civil Engineering.
P. C. D. Milly.
Water Resources Research, Vol. 20, No. 8, p 1075-1085, August, 1984. 6 Fig, 2 Tab, 16 Ref.

Descriptors: *Evaporation rate, *Linear analysis, *Thermal effects, *Soil water, Moisture flux, Thermal liquid flux, Soil temperature.

Evaporation of water from a soil surface is a complex process that can be strongly tied to the distribution of temperature in the soil. One way of examining this coupling is through linearization and analytic solution of the partial differential equations and boundary conditions that govern the distributions of moisture and temperature. The solution for a step change in temperature and matric head at the surface of a soil that is initially isothermal and uniformly wetted suggests that evaporation can be calculated accurately by neglecting the dependence of moisture content on temperature, even when the associated 'thermal liquid flux' is the largest moisture flux immediately beneath the soil surface. The resulting error decreases with the hydrothermal diffusivity ratio, eta, which is the ratio of soil moisture diffusivity to soil thermal diffusivity, and increases with the thermal liquid force ratio, xi, which is proportional to the poorly understood temperature coefficient of matric head. In contrast, the solution for diurnally varying evaporation from a relatively dry soil shows that the relative error induced by neglecting vapor diffusion due to thermally induced vapor concentration gradients is approximately equal to the relative magnitude of the neglected flux itself. This error is roughly equal to sigma x (eta to the 1/2 power), where the thermal vapor force ratio, sigma, is the ratio of characteristic thermal to isothermal driving forces. Furthermore, when sigma x (eta to the 1/2 power) is large, the daytime switches from a time of maximum evaporation to a time of minimum. This behavior is not reproduced if the thermal vapor flux is ignored. (Authors abstract)
W85-02364

SIMULATION ANALYSIS OF THERMAL EFFECTS ON EVAPORATION FROM SOIL,
Princeton Univ., NJ. Dept. of Civil Engineering.
P. C. D. Milly.
Water Resources Research, Vol. 20, No. 8, p 1087-1098, August, 1984. 9 Fig, 6 Tab, 34 Ref, 1 Append. NSF grant ATM-781237 and ATM-8114723.

Descriptors: *Evaporation, *Thermal effects, *Simulation analysis, *Soil water, Soil temperature, Richard's equation, Water vapor, Vapor pressure, Vapor diffusion.

The Richards equation, which expresses the conservation of water in an isothermal soil, has a more general form in nonisothermal soil. In using the latter, it is necessary to know soil temperature, and modeling becomes considerably more complicated. A detailed numerical simulation model quantifies the thermal effects for two hypothetical soils under two climates. During characteristic 4-day climatic sequences in a season of soil heating, diffusion of vapor due to thermally induced vapor concentration gradients suppresses evaporation. The suppression is greatest (5-15% in this set of experiments) under arid conditions. Under these conditions, such thermal vapor diffusion also distorts the usual diurnal pattern of evaporation. Evaporation is generally more sensitive to isothermal than to thermal vapor diffusion. Variations in time and depth of the soil temperature cause corresponding variations in the water transport coefficients. These, in turn, result in biases (2-5%) and diurnal distortions of evaporation rates. Liquid flow attributable to the dependence of matric potential on temperature accounts for about 1% of evaporation in our experiments. In simulations of 1 month duration for each combination of soil and climate the joint neglect of all thermal effects mentioned above introduces an error of only about 1% in the average evaporation rate and does not distort its time distribution significantly. (Author's abstract)
W85-02365

TECHNIQUES FOR MAKING FINITE ELEMENTS COMPETITVE IN MODELING FLOW IN VARIABLY SATURATED POROUS MEDIA,
GeoTrans, Inc., Reston, VA.
P. S. Huyakorn, and S. D. Thomas.
Water Resources Research, Vol. 20, No. 8, p 1099-1115, August, 1984. 20 Fig, 5 Tab, 22 Ref, 5 Append.

Descriptors: *Finite element method, *Flow modeling, *Porous media, *Saturation, Saturated flow, Picard algorithm, Newton-Raphson algorithm, Galerkin finite element formulation, Algorithms, Capillary conductivity, Soil water.

A Galerkin finite element formulation is developed for the numerical simulation of water flow in variably saturated soil systems. Included in this formulation is a solution strategy based on Picard and Newton-Raphson algorithms. Both algorithms are especially to cope with severely nonlinear field problems. The two algorithms are formulated for both rectangular and triangular elements. The element matrices are evaluated in a simple and efficient manner using a technique referred to as the 'influence coefficient' technique. This technique avoids numerical integration and leads to a substantial saving of computational cost. Four examples are presented to demonstrate the effectiveness of the present finite element approach. These examples show that the nonlinear solution schemes are capable of accomodating cases involving large variations in the saturated hydraulic conductivity, as well as highly nonlinear soil moisture characteristics. A comparative study of the Picard and the Newton-Raphson algorithms is also provided. The study indicates that despite the higher cost per iteration of the Newton-Raphson scheme, it usually requires a substantially smaller number of iterations than the Picard scheme. In some instances where convergence difficulties are experienced with the latter scheme, it is desirable to use the Newton-Raphson scheme in order to obtain a cost-effective solution to the problem. (Author's abstract)
W85-02366

EQUIVALENCE OF TWO CONCEPTUAL MODELS FOR DESCRIBING ION EXCHANGE DURING TRANSPORT THROUGH AN AGGREGATED OXISOL,
California Univ., Davis. Dept. of Land, Air and Water Resources.
P. Nkedi-Kizza, J. W. Biggar, H. M. Selim, M. T. van Genuchten, and P. J. Wierenga.
Water Resources Research, Vol. 20, No. 8, p 1123-1130, August, 1984. 8 Fig, 4 Tab, 32 Ref.

Descriptors: *Ion exchange, *Oxisols, *Model studies, Isotope studies, Breakthrough curves, Calcium radioisotopes, Chlorine radioisotopes, Tritium, Soil columns, Soil water.

Breakthrough curves (BTCs) of the cation Ca-45(2+), an anion Cl-36(-), and labeled H2O were measured during miscible displacement through water-saturated soil columns packed with aggregates of an Oxisol. Two conceptual models were used to simulate the observed asymmetry and tailing in the BTCs caused by an apparent nonequilibrium situation in the porous medium. In both models the exchange process on one type of site was assumed to be instantaneous while the rate of isotopic exchange on another type of site was assumed to be either a diffusion-controlled process (model 1) or a first-order reversible kinetic process (model 2). Isotopic exchange in both models was described with a linear isotherm. It is shown that the two models are mathematically equivalent with respect to the derived BTCs. (Author's abstract)
W85-02368

ALGEBRAIC EQUATIONS FOR SOLUTE MOVEMENT DURING ADSORPTION,
New South Wales Univ., Kensington (Australia). School of Civil Engineering.
K. K. Watson, and M. J. Jones.
Water Resources Research, Vol. 20, No. 8, p 1131-1136, August, 1984. 3 Fig, 2 Tab, 15 Ref.

Descriptors: *Adsorption, *Mathematical equations, *Solute movement, *Solute transport, Porous media, Dispersion, Fick's law, Molecular diffusion, Mechanical dispersion, Diffusion, Boundary conditions.

Numerous contributions have appeared in the literature giving analytical solutions for the movement of nonreactive solute in unsaturated porous materials during adsorption and infiltration. Simple algebraic equations were developed that can be used with confidence for predicting solute disposition during absorption. Quasi-analytical solutions for constant concentration and constant flux boundary conditions using a velocity independent hydrodynamic dispersion coefficient were reduced to a simple yet accurate form. Solutions were also developed for systems where the mechanical dispersion forms the dominant component during dispersion. For systems lying outside the application of the fairly restriced quasi-analytical solutions, a computer-based numerical analysis is required so that calculated data on solute disposition may be obtained both for testing the limitations of the equations and for evaluating any necessary empirical parameters. Systems that lie between the extreme cases where both the molecular diffusion and mechanical dispersion have comparable significance were analyzed and values of an empirical parameter, which is a necessary term in the resulting equation, were determined from computer-based numerical studies. The magnitude of the parameter varies within a reasonably narrow range of values. Equations were also developed from the alternative governing differential equation for solute movement based on a Fickian model. (Collier-IVI)
W85-02369

INVESTIGATION OF THE PROPERTIES AND GENESIS OF WEST COAST WET LAND SOILS, SOUTH ISLAND, NEW ZEALAND; 5. PHYSICAL CHARACTERISTICS OF SOIL PROFILES AND SOIL WATER REGIMES,
New Zealand Soil Bureau, Lower Hutt.
R. J. Jackson.
New Zealand Journal of Science, Vol. 27, No. 2, p 155-174, 1984. 7 Fig, 3 Tab, 19 Ref.

Descriptors: *Soil properties, *Physical properties, *Wetlands, Drainage, Water level, Pore size, Pore water.

Physical characteristics of wet land soils at 8 type localities on the West Coast of South Island are described. Typically the physical characteristics show very large changes with depth within each profile, mainly associated with the thickness of the H horizons and the organic matter content and particle-size distribution of the mineral material. Dry bulk density, particle density, and total porosity of the non-stony horizons are dominated by the organic matter content, but the water-retention data show the influence of particle size and of soil structure. At sites under forest, unmodified organic horizons have low dry bulk density, very high large pore contents, and very high available water storage capacities. Most A horizons are humic silt loams with moderate dry bulk densities, large pore contents between 2 and 20% v/v, and available water contents of 30-50% v/v. Both H and Ah horizons show substantial shrinkage during determinations of water retention characteristics. In many profiles the amount of available water that is in the readily available category decreases with depth. Removal or severe modification of surface horizons, which may occur with land development, would result in greatly increased potential for drying of the underlying horizons during periods when weather conditions permit drying to occur. Many of these profiles of wet land soils have low contents of large pores in horizons at shallow depths. In such horizons quite large changes of the position of the water table occur without much change in the air-filled pore space, and drainage alone is unlikely to improve air movement. (Baker-IVI)
W85-02411

SIMULATION OF THE BEHAVIOUR OF NITROGEN IN SOILS (SIMULATION DE L'IMPACT DE PRODUITS REACTIFS DANS LES SOLS - CAS DE L'AZOTE),
Centre National de la Recherche Scientifique, Toulouse (France). Inst. de Mecanique des Fluides.
For primary bibliographic entry see Field 5B.
W85-02460

ORIGIN AND DISTRIBUTION OF CARBON DIOXIDE IN THE UNSATURATED ZONE OF THE SOUTHERN HIGH PLAINS OF TEXAS,
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 2K.
W85-02661

GEOSTATISTICAL APPROACH TO SOLUTE TRANSPORT IN HETEROGENEOUS FIELDS AND ITS APPLICATIONS TO SALINITY MANAGEMENT,
Agricultural Research Organization, Bet-Dagan (Israel). Div. of Soil Physics.
For primary bibliographic entry see Field 5B.
W85-02668

2H. Lakes

SINKING LOSSES OF PHYTOPLANKTON IN CLOSED LIMNETIC SYSTEMS,
Freshwater Biological Association, Ambleside (England).
C. S. Reynolds, and S. W. Wiseman.
Journal of Plankton Research, Vol. 4, No. 3, p 489-522, 1982. 21 Fig, 4 Tab, 37 Ref.

Descriptors: *Phytoplankton, *Sinking, *Blelham Tarn, *England, Sedimentation, Lakes, Algae, Diatoms, Temporal distribution, Vertical distribution, Productivity, Standing crop, Biomass.

Loss processes, resulting in the elimination of viable algae from the trophogenic zones of lake, exert important controls on the productivity of the phytoplankton, the standing crop, and, to some extent, its periodicity. Sedimentation losses are studied as a part of a study of the magnitude and variation of loss processes. Specific algal recoveries from sediment traps of two different designs and from mud surface deposits of large experimental enclosures (Lund Tubes) placed in Blelham Tarn (England) were monitored during 1978 and are analyzed in relation to the vertical and temporal distribution of ten dominant phytoplankton populations. Sedimentation accounts for differing proportions of the total loss of biomass for different algae: between 28 and 100% of diatoms; 15-95% of Eudorina; <4% of populations of small algae (species of Ankyra, Chromulina, Cryptomanas). Rates of diatom loss are also derived from comparison of net rates of change (kn) and the silica uptake-derived growth rate (k'); intrinisic sinking behavior may be specifically regulated in relation to growth conditions. Temporal and specific differences in sinking behavior have two important implications in phytoplankton ecology. The first is that different species respond differently to given conditions of physical stability. The second point is that sinking losses can make a substantial impact upon the dynamics of phytoplankton. (Moore-IVI)
W85-02215

EFFECTS OF LAKE ACIDIFICATION ON RATES OF ORGANIC MATTER DECOMPOSITION IN SEDIMENTS,
Winnipeg Univ. (Manitoba). Dept. of Biology.
For primary bibliographic entry see Field 5C.
W85-02218

PRIMARY PRODUCTION AND GRAZING IN FRESHWATER AND INTERTIDAL REACHES OF A COASTAL STREAM, SOUTHEAST ALASKA,
M. L. Murphy.
Limnology and Oceanography, Vol. 29, No. 4, p 805-815, July, 1984. 5 Fig, 4 Tab, 24 Ref.

Descriptors: *Porcupine Creek, *Alaska, *Primary productivity, *Grazing, *Intertidal areas, Periphyton, Invertebrates, Biomass, Shade, Isopods, Amphipods.

During summer 1981, primary production of periphyton and grazing by macroinvertebrates were measured in Porcupine Creek, a small stream in Southeast Alaska. The intertidal reach was in a meadow primarily of sedge (Carex sp.); the freshwater reach was in a mature forest of western hemlock (Tsuga heterophylla) and Sitka spruce (Picea sitchensis). Daily net primary production was 50% greater in the intertidal reach (mean = 486 mg C/sq m) than in the freshwater reach (mean = 324 mg C/sq m). In the freshwater reach, periphyton had high biomass (mean = 7.8 C/sq m, 95% C.I. = 4.9-10.7 g C/sq m) and low production: biomass ratio (0.04), shade of the forest canopy limited primary production. In the intertidal reach, periphyton had low biomass (mean = 2.0 g C/sq m, 95% C.I. = 1.3-2.7 g C/sq m) and high production: biomass ratio (0.24), and grazing macroinvertebrates limited primary production by reducing the biomass of periphyton. Mean daily net production in the intertidal reach could supply about 3.8 kcal/sq m/d and satisfy 200% of the daily energy requirement for maintenance and activity of the population of macroinvertebrates in the reach, primarily the isopod Gnorimosphaeroma oregonensis and amphipods Paramoera columbiana and Eogammarus confervicolus. Autochthonous primary production by periphyton is probably the dominant source of energy in summer for secondary producers in the intertidal reach of Porcupine Creek. (Author's abstract)
W85-02219

TRANSPORT OF CARBON, NITROGEN, PHOSPHORUS, AND MAJOR SOLUTES IN THE GAMBIA RIVER, WEST AFRICA,
California Univ., Santa Barbara. Dept. of Biological Sciences.
L. F. W. Lesack, R. E. Hecky, and J. M. Melack.
Limnology and Oceanography, Vol. 29, No. 4, p 816-830, July, 1984. 8 Fig, 7 Tab, 46 Ref. NSF grant DEB81-11398.

Descriptors: *Solute transport, *Carbon, *Nitrogen, *Phosphorus, *Gambia River, *West Africa, Silicon dioxide, Carbonates, Organic carbon, Hysteresis, Particulates, Lithology, Relief.

Transport of solutes and particulate materials and their variation with discharge were studied for 1 year (July 1980-June 1981) in the Gambia River in the tropical savanna of West Africa. The water is dilute (flow-weighted mean total solutes, 40.6 mg/liter) solution of SiO2 and HCO3 (75% of total solutes by weight). Na(+), K(+), Cl(-), and total dissolved nitrogen showed no significant relation with discharge. Ca(2+), Mg(2+), HCO3(-), conductivity, and SO4(2-) decreased as discharge increased, while total dissolved phosphorus increased with discharge. After an initial increase SiO2 was independent of discharge. Dissolved organic carbon displayed counterclockwise hysteresis with rising and falling discharge. Particulate phosphorus and total particulate materials displayed clockwise hysteresis. Total transport amounted to 9.66 t/sq km/yr. The transport rates of both dissolved and particulate organic C are among the lowest ever reported. The low transport of total particulates and solutes is attributed to lack of relief and the lithology of the catchment. (Author's abstract)
W85-02220

TURBULENT MIXING IN THE HYPOLIMNION OF BALDEGGERSEE (SWITZERLAND) TRACED BY NATURAL RADON-222,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
D. M. Imboden, and Th. Joller.
Limnology and Oceanography, Vol. 29, No. 4, p 831-844, July, 1984. 9 Fig, 6 Tab, 25 Ref.

Descriptors: *Mixing, *Turbulence, *Hypolimnion, *Baldeggersee, *Switzerland, *Radon, Diffusion, Radioactive tracers, Mathematical models, Buoyancy, Water temperature.

Three analytical diffusion models are used to describe the distribution of a nonconservative tracer in the hypolimnion of a lake: The one-dimensional vertical (1-DV) model, developed for tracers in the deep sea, leads to a significant overestimation of vertical diffusivity Kz in lakes; the one-dimensional topographic vertical (1-DTV) model, applicable if horizontal mixing is fast compared to in situ decay, demonstrates that, except for the deepest layers, vertical tracer distributions are insensitive to Kz; the one-dimensional topographic horizontal (1-DTH) model, in which horizontal mixing is incomplete and vertical diffusion is disregarded, is the appropiate model for the interpretation of vertical excess Rn-222 profiles a few meters above the lake bottom. The radon flux F from the bottom is calculated from Rn-222 in the sediments and corrected for depth variation of porosity and radium activity. In Baldeggersee (Switzerland), F is 390 +/- 70 dpm/sq m/d. Radium activities in the sediments are 0.7 +/- 0.2 dpm/g dry mass, similar to those in other Swiss lakes and in coastal areas of the ocean but 20-50 times smaller than in the deep Pacific. Horizontal diffusivity in the hypolimnion decreases from June (5,000 sq m/d) to October (1,000 sq m/d); vertical diffusivity is between 1 and 10 sq m/d, roughly 10 times larger than values calculated from temperature in the upper hypolimnion. Vertical buoyancy flux is between 10-11 and 10-10 sq m/s cu, i.e. between values for the deep ocean and the small ELA lakes in Canada. The large Kz and the transient, often irregular shape of the randon profiles are the result of horizontal bottom currents previously measured by other methods. (Author's abstract)
W85-02221

CLASSIFICATION AND DYNAMIC SIMULATION OF THE VERTICAL DENSITY STRUCTURE OF LAKES,
Western Australia Univ., Nedlands. Dept. of Civil Engineering.
J. C. Patterson, P. F. Hamblin, and J. Imberger.
Limnology and Oceanography, Vol. 29, No. 4, p 845-861, July, 1984. 11 Fig, 2 Tab, 22 Ref.

Descriptors: *Density stratification, *Limnology, *Simulation, Lake basins, Wind, Mixing, Water circulation, Shear, Mathematical models, Thermal inversion, Water temperature, Salinity.

Field data from two lakes of widely differing geometry and size are analyzed in terms of four nondimensional numbers which allow the principal mixing processes in each lake to be identified. The numbers are based on basin geometry, density stratification, wind stress, and rates of inflow and outflow. The procedure highlights the differences in the dynamics of the two lakes and allows assessment of the validity of the assumption of one-dimensionality. The result is that both lakes were dominated by one-dimensional, but different processes. The dynamics of the epilimnion of the smaller lake were dominated by stirring from surface wind and cooling, whereas shear at the pycnocline was also significant in the larger lake. In neither case did the effects of the earth's rotation, inflow, or outflow generate significant horizontal gradients. A one-dimensional numerical model (DYRESM) was used to simulate the vertical temperature and salinity structures of both lakes over lengthy periods, with good results. The model is based on the parameterization of the important physical processes in a framework of horizontal layers of variable thickness and was applied in both lakes without alteration. The interpretative power of the model is demonstrated by examination of the formation and erosion of a thermal inversion in the larger lake. (Author's abstract)
W85-02222

MIXING AND THE DYNAMICS OF THE DEEP CHLOROPHYLL MAXIMUM IN LAKE TAHOE,
Scripps Institution of Oceanography, San Diego, CA.
M. R. Abbot, K. L. Denman, T. M. Powell, P. J. Richerson, and R. C. Richards.
Limnology and Oceanography, Vol. 29, No. 4, p 862-878, July, 1984. 14 Fig, 42 Ref.

Descriptors: *Lake Tahoe, *Deep chlorophyll maximum, *Mixing, *Water temperature, Productivity, Nutrients, Turbulence, Solar radiation, Seasonal variation.

Chlorophyll-temperature profiles were measured across Lake Tahoe about every 10 days from April through July 1980. Analysis of the 123 profiles and associated productivity and nutrient data identified three important processes in the formation and dynamics of the deep chlorophyll maximum (DCM): turbulent diffusion, nutrient supply rate, and light availability. Seasonal variation in these processes resulted in three regimes: a diffusion-dominated regime with a weak DCM, a variable-mixing regime with a pronounced, nutrient supply-dominated DCM, and a stable regime with a deep, moderate light availability-dominated DCM. The transition between the first two regimes occurred in about 10 days, the transition between the last two more gradually over about 3 weeks. The degree of spatial variability of the DCM was highest in the second regime and lowest in the third. These data indicate that the DCM in Lake Tahoe is constant in neither time nor space. (Author's abstract)
W85-02223

DIEL VARIATION OF NITROGEN FIXATION IN LAKE VALENCIA, VENEZUELA,
Colorado Univ. at Boulder. Dept. of Environmental, Population, and Organismic Biology.
S. N. Levine, and W. M. Lewis, Jr.
Limnology and Oceanography, Vol. 29, No. 4, p 887-893, July, 1984. 2 Fig, 1 Tab, 19 Ref. NSF Grants DEB 78-05324 and DEB 80-03883.

Descriptors: *Nitrogen fixation, *Lake Valencia, *Venezuela, *Diel variation, Cyanophyta, Eutrophic lakes, Heterocysts.

Using data from incubations in situ, light measurements, and heterocyst counts, two major causes of variation in nitrogen fixation were determined: change in abundance of nitrogen fixers at a given depth and change in heterocyst-specific nitrogen fixation. Lake Valencia is eutrophic and sustains large populations of blue green algae. During the months when Lake Valencia was circulating and during the early weeks of stagnation, when dissolved inorganic nitrogen was still relatively abundant, the nitrogen fixation rates during diel studies were rarely significantly different from zero. Studies while the nitrogen fixers were abundant and active showed fairly regular diel patterns. The rate of nitrogen fixation at 0.5 m was strongly dependent on the concentration of heterocystous blue-green algae, which changed with time of day. Four species of heterocystous blue-green algae were common to the lake during 1981: Anabaena volzii, A. spiroides, Cylindrospermopsis stagnale, and Anabaenopsis circularis. The volume-specific nitrogen fixation rates (nitrogen fixed/liter/hr) at 0.5 m were lowest at night, being < 6% of the maximum daytime rates. Heterocyst-specific nitrogen fixation did not follow the same diel trends as volume-specific nitrogen fixation. During most of the day, the heterocyst-specific nitrogen fixation rates were fairly uniform, between 31 and 37 nmol/hr in September. At night, heterocyst-specific nitrogen fixation was 3.0 nmol/hr in September. (Baker-IVI)
W85-02224

HUMIC SUBSTANCES IN AMAZONIA I: CHEMICAL CHARACTERIZATION OF HUMIC AND FULVIC ACIDS FROM TWO CENTRAL AMAZONIA LACUSTRINE SEDIMENTS (BLACK AND WHITE WATER SYSTEMS),
Universidade Federal de Sao Carlos (Brazil). Dept. de Quimica.
A. D. Santos, and A. A. P. Toledo.
Tropical Ecology, Vol. 24, No. 1, p 143-152, 1983. 5 Fig, 4 Tab, 14 Ref.

Descriptors: *Lake sediments, *Lake Caiaue, *Lake Jacaretinga, *Brazil, Bottom sediments, Humic acids, Fulvic acid, Amazonia, Chemical analysis, Litter.

The material extracted from the two lakes is probably formed by different humification processes. Lakes of the Rio Negro region seem to have substances form by humification from allochthonous material from the forest, where resistant materials such as lignin, tannins and phenols accumulated in the litter under aerobic conditions. A higher concentration of humic and fulvic acids was found in sediments from Caiaue Lake as compared to those from Jacaretinga Lake. The greater concentration of humic and fulvic acids from Caiaue Lake can be explained by the fact that this lake receives humic substances brought down by the Rio Negro, in addition to a substantial amount of material from the forest. Jacaretinga Lake, as well as other varzea lakes in the Careiro region, may have part of these substances removed by the Amazon River waters during flooding seasons. Material extracted from Jacaretinga Lake sediment had a higher nitrogen content than Caiaue Lake, but a lower carbon content. The humic and fulvic acids were characterized by a high predominance of carboxylic acidity in both lakes. The chromaticity coefficient of humic acid for the material from Caiaue was higher than the one from Jacaretinga, suggesting a predominance of aliphatic structure in the humic acid from Caiaue and in the fulvic acid from Jacaretinga. (Baker-IVI)
W85-02234

BIOLOGICAL COMMUNITIES OF THREE SUBTROPICAL FLORIDA LAKES OF DIFFERENT TROPHIC CHARACTER,
University of South Florida, Tampa. Dept. of Biology.
J. L. Elmore, B. C. Cowell, and D. S. Vodopich.
Archiv fur Hydrobiologie, Vol. 100, No. 4, p 455-478, July, 1984. 6 Fig, 5 Tab, 48 Ref.

Descriptors: *Benthos, *Lakes, *Trophic level, *Florida, Phytoplankton, Zooplankton, Macrobenthos, Meiobenthos, Protozoa, Eutrophication.

Phytoplankton, zooplankton, macrobenthos, meiobenthos, and protozoans were sampled during 1979-1980 in three subtropical lakes of differing trophic state in central Florida. The phytoplankton of Lake Beauclair (hypereutrophic) was dominated by Cyanophyta (52%) and Chlorophyta (38%). In Corner Lake (mesotrophic) the dominant divisions were the same as in Lake Beauclair, but Chloro-

phyta (59%) was more abundant than Cyanophyta (35%). Bay Lake (oligotrophic) was dominated by Chlorophyta (54%) and Cryptophyta (31%). Rotifers (63%) were the most important zooplankters in Lake Beauclair, with crustaceans comprising 37% of the numerical density. Corner Lake had almost equal proportions of rotifers (52%) and crustaceans (49%), whereas crustaceans (64%) were more abundant than rotifers (36%) in Bay Lake. Phytoplankton and zooplankton increased, whereas macrobenthos decreased with increasing lake trophic state. Meiobenthos densities decreased from Bay Lake to Corner Lake and then increased somewhat in Lake Beauclair. If nematodes are excluded, meiobenthos abundance shows a strong inverse correlation with trophic state. Protozoan densities exhibited little difference between Bay Lake and Corner Lake, but Lake Beauclair had a much greater abundance than the other lakes. Nutrient levels were probably most important in causing increases in densities of phytoplankton, zooplankton, and protozoans with increasing trophic state. Decreasing densities of benthos with increasing trophic states were likely caused by differences in levels of dissolved oxygen near the sediment water interface. (Baker-IVI)
W85-02240

ELEMENTAL RESIDENCE TIMES IN ACTON LAKE, OHIO,
Yale Univ., New Haven, CT. Dept. of Geology and Geophysics.
D. E. Canfield, W. J. Green, T. J. Gardner, and T. Ferdelman.
Archiv fur Hydrobiologie, Vol. 100, No. 4, p 501-519, July, 1984. 8 Fig, 3 Tab, 28 Ref.

Descriptors: *Lakes, *Chemical properties, *Acton Lake, *Ohio, Seasonal variation, Physical properties, Biological properties, Sodium, Chloride, Calcium, Manganese, Magnesium, Iron, Water quality.

Elemental residence times in the lake were controlled by several specific, physical, chemical and biological processes. Residence time trends for Ca were seasonal when compared to conservative behavior, with biologically induced calcite precipitation the main removal mechanism. Residence times for Fe and Mn were long, with bottom sediment resuspension and anoxic regeneration the most important contributors. Terrestrial organic decomposition and sediment resuspension were probably responsible for the long residence times observed for K. Mg, Na, and Cl are conservative in Acton Lake. Results from this study may be extended to predict residence time behavior in other systems since the same processes controlling elemental residence times in Acton Lake may also affect residence times in other lakes. Residence times for iron and manganese may be in general long in shallow, eutrophic lakes where the ratio IAP/Ksp exceeds one. Sodium and chloride should behave conservatively in most lakes. In lakes where bottom sediment resuspension is important in affecting lake chemistry, residence times for many toxic trace metals may be long, possibly affecting water quality. (Baker-IVI)
W85-02241

LEAF LITTER PROCESSING RATES IN FOUR TEXAS STREAMS,
Southwest Texas State Univ., San Marcos, Aquatic Station.
R. A. Short, S. L. Smith, D. W. Guthrie, and J. A. Stanford.
Journal of Freshwater Ecology, Vol. 2, No. 5, p 469-473, August, 1984. 2 Tab, 10 Ref.

Descriptors: *Litter, *Streams, *Texas, Organic matter, Decomposition, Water temperature, Invertebrates.

Rates of leaf liter processing were investigated in four Texas streams during fall-winter. Assuming an exponential decay model, processing coefficients of some leaf species were among the highest yet reported. Processing coefficients for the various leaf species ranged from 0.0040 for sycamore in the Blanco River to 0.0619 for hackberry in Honey Creek. Values for percent loss/day ranged from 0.54 to 6.00. When compensated for the higher water temperatures found in these streams compared to more northern streams, processing rates were equivalent or even slightly lower. It is hypothesized that (on a per degree day basis) this slower processing rate may result from the depauperate shredder fauna in such Texas streams. Ecosystem level studies of invertebrate community structure and associated mechanisms of energy transfer via processing of particulate organic matter are needed to clarify the apparently different strategies present in the more unpredictable environment of many Texas streams. (Baker-IVI)
W85-02247

USE OF NEPHELOMETRIC TURBIDITY TO CALCULATE CARLSON'S TROPHIC STATE INDEX IN KEYSTONE LAKE OKLAHOMA,
Corps of Engineers, Vicksburg, MS.
R. G. Hunter, and J. Wilhm.
Journal of Freshwater Ecology, Vol. 2, No. 5, p 475-485, August, 1984. 5 Fig, 3 Tab, 20 Ref.

Descriptors: *Turbidity, *Lakes, *Keystone Lake, *Oklahoma, Chlorophyll, Phosphorus, Water quality, Nephelometric Turbidity, Mathematical equations, Trophic level.

Relationships among measurements of turbidity and chlorophyll and phosphorus were examined at six stations in Keystone Lake, Oklahoma from March to October of 1981. Maximum chlorophyll a, total phosphorus, and turbidity occurred in the upper reaches of the two main arms. Total phosphorus of all samples ranged from less than 3 to 66 mg/cu m and averaged 14 mg/cu m. Chlorophyll a of all samples ranged from 3 to 65 mg/cu meter averaging 23 mg/cu m. Secchi disc transparency ranged from 0.3 to 5 m and varied significantly by both station and date. Chlorophyll a concentration could not be predicted adequately from Secchi disc readings due to interference by non-chlorophyll turbidity. Secchi disc depth represented 30 to 50% of the true photic zone and these two parameters were well correlated. Photic zone depth ranged from 0.8 to 4.8 m, varied significantly with both station and date and was poorly correlated with phosphorus and chlorophyll a. Nephelometric turbidity was strongly correlated with all parameters except chlorophyll a. Carlson's trophic state index was of limited usefulness due to the weak relationship among parameters such as chlorophyll a and Secchi disc depth. Calculation of this index based on nephelometric turbidity strengthened the relationship. The addition of nephelometric turbidity of Carlson's index was accomplished by setting a 0 value of the index equal to 200 NTU. When mean values were plotted by station or date, a good correlation existed between Secchi disc transparency and photic zone measurements made with the submarine photometer. (Baker-IVI)
W85-02248

SESTON MICROBIAL ACTIVITY IN A RIVER-RESERVOIR SYSTEM,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
P. F. Kondratieff, and G. M. Simmons, Jr.
Journal of Freshwater Ecology, Vol. 2, No. 5, p 487, August, 1984. 4 Fig, 72 Ref.

Descriptors: *Seston, *Reservoirs, *Rivers, *Water quality, *Microbiological studies, Hypolimnion, Aquatic drift, Dam effects, Reservoirs, Detritus, Chlorophyll a, Sedimentation.

Organic seston was studied in a 3rd-4th order impounded river in southwestern Virginia. The hypolimnetic release reservoir had an area of 67 ha and was located in a 4860 ha watershed, 90% of which was forested. The study was to determine reservoir effects on seston quality by measuring microbial activity and chlorophyll a on river and reservoir seston. The reservoir interrupted the lotic seston pathway in the Dan River. In general, the longer detritus is recycled within a system the more refractory it becomes to microbial and animal metabolism. The reservoir eliminated much of the riverine particulate seston from suspension and thereby increased the possibility that reservoir generated seston could be of overall higher quality. Within the impoundment, autochthonous production and microbial ETS activity were significantly higher than at upstream riverine sites and at a site immediately below the dam. The reservoir seston was therefore of considerably higher quality than either imports or exports. Five km below the impoundment, chlorophyll a concentrations were consistently low while ETS activity increased significantly from that at the station immediately below the dam. Through mechanisms such as sedimentation of imported seston, substantial in-reservoir autotrophic production, and high downstream microbial activity, impoundments on rivers may contribute to maximizing lotic ecosystem efficiencies. (Baker-IVI)
W85-02249

TRANSFORMATION AND DECOMPOSITION OF PHOTOSYNTHETIC PRODUCTS OF LAKE PHYTOPLANKTON,
Tokyo Metropolitan Univ. (Japan). Dept. of Biology.
Y. Watanabe.
Japanese Journal of Limnology, Vol. 45, No. 2, p 116-125, April, 1984. 5 Fig, 2 Tab, 26 Ref.

Descriptors: *Lakes, *Limnology, *Phytoplankton, *Decomposition, *Photosynthesis, Organic matter, Bacteria, Particulate matter.

The transformation and decomposition processes of newly assimilated photosynthetic products on lake phytoplankton were followed. The amount of refractory and labile particulate organic matter and dissolved organic matter derived from both the cellular and extracellular organic matter was determined using a C-14 tracer method under controlled laboratory conditions. Cellular organic matter was consumed by phytoplankton respiration in the early stages of incubation and decreased to 19% of the initial amount for 30 days at 25 C. A shift occurred in the chemical constitution of the predominant cellular organic matter: hot ethanol soluble and hot water soluble components became hot water insoluble. After decomposition for 85 days, 14.7% and 1.5% of the cellular products were transformed to particulate and dissolved organic matter, respectively. The extracellular products, which were 9.3% of the total photosynthetic products, were easily metabolized and decomposed by lake bacteria. After 133 days, 19.4% and 7.5% of the initial extracellular products were changed to particulate and dissolved organic matter, respectively. During the course of the decomposition, a marked difference was noted in the gel filtration profile of the dissolved organic matter derived from the extracellular products. (Baker-IVI)
W85-02254

ANNUAL PRODUCTION BY GAMMARUS PSEUDOLIMNAEUS AMONG SUBSTRATE TYPES IN VALLEY CREEK, MINNESOTA,
Minnesota Univ., St. Paul. Dept. of Entomology, Fisheries, and Wildlife.
T. F. Waters.
American Midland Naturalist, Vol. 112, No. 1, p 95-102, July, 1984. 2 Tab, 40 Ref.

Descriptors: *Valley Creek, *Minnesota, *Gammarus, *Substrates, *Aquatic productivity, Productivity, Invertebrates, Amphipods, Benthos, Silting, Sand, Gravel, Cobble.

In high alkalinity, spring-fed streams, species of Gammarus frequently constitute the predominant biomass component of the invertebrate standing stock and are a main element of a stream system's production and energy flow. Annual production by Gammarus pseudolimnaeus Bousfield in Valley Creek, Minnesota, was computed, using the size-frequency method, separately by substrate type for the 5-year period, 1968-1972. Four substrate types were identified: sand, sand-gravel, gravel, and cobble. Annual production was higher in fine-particle substrates than in coarse-particle substrates. The 5-year means were: sand, 21.4; sand-gravel, 21.8; gravel, 15.0; and cobble, 11.0 g/sq m (dry weight). The ratio of annual production to annual mean standing stock (P/B) ranged mostly from 5.5-6.5, with 6.0 being the 5-year mean of all substrates combined. Densities and standing stocks were also higher in fine-particle substrates and

were also affected more by the siltation in fine-particle substrates. The siltation that occurred in the middle years of the study apparently filled much of the interstitial space with clay reducing the usable space in the fine-particle substrates realtively more than in coarse substrates. Production was lowest in all substrates in 1971, the year most severely affected by the siltation. (Collier-IVI)
W85-02279

SEASONAL SPATIAL AND TEMPORAL PHYTOPLANKTON CHANGES IN A SHALLOW EUTROPHIC LAKE,
Alberta Univ., Edmonton. Dept. of Botany.
C. G. Jenkerson, and M. Hickman.
Nova Hedwigia, Vol. 39, No. 1-2, p 1-33, 1984. 16 Fig, 2 Tab, 68 Ref. Natural Sciences and Engineering Research Council of Canada grant A6384.

Descriptors: *Hastings Lake, *Alberta, *Phytoplankton, *Eutrophic lakes, *Seasonal distribution, *Physicochemical properties, Algae, Cyanophyta, Diatoms, Chrysophyta, Chlorophyta, Nitrate, Species diversity, Water temperature, Light intensity.

Phytoplankton fluctuations in Hastings Lake, Alberta, Canada, were investigated in relation to physicochemical parameters. The lake is edaphically eutrophic, characterized by clinograde oxygen distributions. The phytoplankton was dominated by cyanophycean algae during the summers (e.g., Anabaena circinalis, A. flos-aqua, Aphanizomenon flos-aquae, Microcystis aeruginosa, Oscillatoria subbrevis, Merismopedia tenuissima and Coelosphaerium naegelianum). Two cyanophytes were also winter dominants (e.g., Gomphosphaeria lacustris v. compacta and Lyngbya lagerheimii) along with Chlamydomonas spp., Gonium sociale and Rhodomonas minuta. Stephanodiscus hantzschii was the only dominant diatom. In general chlorophytes showed spring and autumn activity, when temperature and light changed rapidly, and dominated during winters also. A tolerance for winter low temperature and light was shown in negative correlations with those factors. Populations maintained a modicum of growth under low temperature and light were dominants, out-competing the blue-greens as winter nitrate levels were high. Almost all chlorophycean dominants showed positive correlation with nitrate. Spring and summer species responded to moderated temperature and light conditions with population peaks and community dominance again outcompeting blue-greens as nitrate levels were not at summer lows. Diversity was low in winter and summer and high in spring and autumn. (Collier-IVI)
W85-02282

WATER CHEMISTRY AND PHOSPHATASE ACTIVITY OF THE BLUE-GREEN ALGA RIVULARIA IN UPPER TEESDALE STREAMS,
Durham Univ. (England). Dept. of Botany.
D. Livingstone, and B. A. Whitton.
Journal of Ecology, Vol. 72, No. 2, p 405-421, July, 1984. 7 Fig, 7 Tab, 33 Ref.

Descriptors: *Upper Teesdale, *England, *Phosphatase activity, *Cyanophyta, *Rivularia, *Chemical properties, Algae, Phosphate, Phosphorus, Hydrogen ion concentration.

Rivularia colonies are abundant and sometimes dominant in many streams in Upper Teesdale, northern England. In three stream systems chosen for intensive survey, the alga was restricted to sites combining drainage from both peat and limestone. Water chemical variables were measured monthly over a year (March 1981-February 1982). Most changes at the main Rivularia sites were probably due to varying combinations of drainage from peat, limestone and ores rich in zinc, lead or barium. Mean concentration of filterable phosphate (as P) from three main sites was 87 micro g/L. Less than 3% of this phosphate was reactive; the remainder (hydrolyzed by persulfate digestion method) was apparently organic. Most of the phosphorus passed down the streams in March-May, with 'filterable organic' phosphate (as P) reaching 1.0 mg/L in two streams in May. In contrast, both organic and reactive phosphate were near or below detection limits (3 micro g/L, 1 micro g/L respectively) for the other months (June-February). Rivularia colonies were shown by two independent methods to have marked alkaline phosphatase activity. The response of the phosphatase to pH was the same for populations from all three streams. Stream water contained active phosphatase. Because the morphology of Rivularia trichomes indicates that the alga is growing under phosphate-limited conditions, it is suggested that one important reason for its success in these streams is its ability to hydrolyze organic phosphates. (Author's abstract)
W85-02283

HYPOLIMNETIC PHOSPHORUS RETRIEVAL BY DIEL VERTICAL MIGRATIONS OF LAKE PHYTOPLANKTON,
Helsinki Univ., Lammi (Finland). Lammi Biological Station.
K. Salonen, R. I. Jones, and L. Arvola.
Freshwater Biology, Vol. 14, No. 4, p 431-438, August, 1984. 5 Fig, 26 Ref.

Descriptors: *Lake Nemeton, *Finland, *Phytoplankton, *Phosphorus, *Migration, *Hypolimnion, Bog lakes, Chemical stratification, Stratification, Euphotic zone, Epilimnion, Nitrogen, Thermocline.

In the boreal forest zone, small sheltered bog lakes can develop intense and very stable stratification patterns with extremely sharp vertical gradients of chemical conditions. In such lakes the euphotic zone closely coincides with the epilimnion. Experiments to assess the possibility that migrating phytoplankton could gain access to hypolimnetic phosphorus and then transport it to the euphotic zone were carried out during summer, 1982, in Lake Nemeton, a small dystrophic lake in the Evo district of southern Finland. Movement of P-33 from hypolimnion to epilimnion was investigated using small-diameter experimental tubes enclosing thermally stratified water columns. The vertical distribution of inorganic phosphorus in the lake showed a sharp increase across the thermocline so that enhanced concentrations were available to phytoplankton just below the thermocline. Inorganic nitrogen concentrations did not show a marked relation to thermal stratification. One abundant motile alga (Cryptomonas marssonii) showed striking and regular vertical migrations in the lake, moving below the thermocline at night and returning to the surface waters in early morning. These migrations took cells across a 10 degree C temperature gradient. Non-motile phytoplankton showed constant vertical distributions. In the experimental tubes an upward movement of phosphorus took place from hypolimnion to epilimnion which was only attributable to transport by phytoplankton cells undertaking active vertical migrations. (Collier-IVI)
W85-02286

ROLE OF TALL AND MEDIUM SPARTINA ALTERNIFLORA ZONES IN THE PROCESSING OF NUTRIENTS IN TIDAL WATER,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
T. G. Wolaver, and J. Zieman.
Estuarine, Coastal and Shelf Science, Vol. 19, No. 1, p 1-13, July, 1984. 4 Fig, 3 Tab, 37 Ref.

Descriptors: *Spartina, *Nutrients, *Nutrient exchange, *Carters Creek, *Virginia, *Tidal Rivers, Cycling nutrients, Nitrogen, Phosphorus, Nutrient removal, Ammonium, Nitrates, Phosphates, Nitrite, Marshes, Tidal marshes, Wetlands, Seasonal variation.

A nitrogen and phosphorus nutrient exchange study was conducted on a vegetated mesohaline marsh in the Carters Creek area, Virginia. The low marsh, dominated by tall Spartina alterniflora removed NH4(+), NO3(-), PO4(3-), dissolved organic nitrogen (DON), dissolved organic phosphorus (DOP), particulate nitrogen (PN), and particulate phosphorus from the tidal water as it traversed this zone on an annual basis, while all the nitrogen and phosphorus species were removed from the tidal water inundating the high marsh (medium S. alterniflora). Nitrite was the only nutrient which was released into the tidal water on an annual basis, this occurring in the low marsh during the fall. The low marsh functioned differently from the high marsh in that (1) most of the nitrogen and phosphorus was removed from the tidal water as it resides on the low marsh (areal basin), and (2) seasonal changes in flux direction for NH4(+), DON, DOP, and PN were observed. The nutrients removed from the tidal water can potentially supply all of the nitrogen and phosphorus required for plant production in the low marsh and between 30 and 105 percent of the nitrogen and 60-70 percent of the phosphorus needed by the high marsh. (Author's abstract)
W85-02287

DEOXYGENATION AND REMINERALIZATION ABOVE THE SEDIMENT-WATER INTERFACE; AN IN SITU EXPERIMENTAL STUDY,
Commonwealth Scientific and Industrial Research Organization, Cronulla (Australia). Div. of Fisheries Research.
N. C. Bulleid.
Estuarine, Coastal and Shelf Science, Vol. 19. No. 1, p 15-25, July, 1984. 7 Fig, 2 Tab, 32 Ref.

Descriptors: *Sediment-water interface, *Mineralization, *Deoxygenation, *Estuarine environment, *Detritus, Ammonium, Phosphates, Oxygen, Anoxic conditions, Cycling nutrients, Nitrogen, Nutrient flux.

An in situ chamber of volume 388 l and bottom area 0.64 sq m was used to determine the flux of oxygen and inorganic nutrients across an estuarine sediment-water interface over a 65-day period. Over the first 7 days, oxygen uptake was 378 mg/sq m/day and the rates of ammonium and phosphate release were 2.22 and 0.34 mg at./sq m/day, respectively. The water became anoxic in 14 days. The rates of flux in a similar chamber containing only detritus recently settled from the water column were 371 mg/sq m/day (oxygen), 1.66 mg at./sq m/day (ammonium) and 0.12 mg at./sq m/day (phosphate), demonstrating that detritus contributes substantially to exchange across the sediment-water interface. The evolution of the two chambers was similar over the latter part of the experimental period. A third chamber containing only water exhibited very minor changes. The role of detritus in nutrient recycling at the sediment-water interface is discussed in relation to the productivity of shallow water bodies such as the estuary in which the experiment was conducted, which itself undergoes periodic deoxygenation during prolonged stratification. The measured flux of nitrogen across the interface was found to represent approximately 31% of the mean daily phytoplankton requirement. (Author's abstract)
W85-02288

GAS CHROMATOGRAPHIC METHOD FOR THE DETERMINATION OF ELEMENTAL SULPHUR IN SEDIMENTS,
Waterworks of Hajdu-Bihar County, Debrecen (Hungary).
For primary bibliographic entry see Field 5A.
W85-02305

ASSESSMENT OF THE TROPHIC STATE OF A WATER BODY,
Commission of the European Communities, Ispra (Italy). Dept. of Physical and Natural Sciences.
O. Ravera.
Annales de Limnologie, Vol. 19, No. 3, p 229-234, 1983. 16 Ref.

Descriptors: *Trophic level, *Public opinion, *Lake classification, *Lake stages, Lake Monate, Italy, Phosphorus, Chlorophyll, Eutrophication, Transparency, Nutrients, Solar radiation, Turbidity, Macrophytes, Zooplankton.

The trophic level of a lake may be judged scientifically as well as by public perception. Agreement is not always perfect between limnologists and the public as to what the optimum value of some parameters, such as transparency, should be. A classification of lakes according to their trophic level may be based on well defined limits between

successive levels on a numerical trophic scale. Natural classifications have been developed based on the probability that a given lake will, with a certain mean concentration of phosphorus and chlorophyll, belong to a given trophic category. A model adopted as a guideline to predict the trophic level of lakes studied in the framework of the OECD's 'Eutrophication Programme' (1971-1979) is based on mass-balance concepts. The trophic state of lakes should be assessed according to the relationships between phosphorus load, phosphorus concentration, and chlorophyll concentration that were developed by the OECD program. These relationships facilitate the prediction of what must be done to reduce the phosphorus load and improve the lakes conditions. Deviations from these relationships may be caused by nutrient release from sediments, short hydrological retention time, high mineral turbidity, excessive development of macrophytes, non available forms of phosphorus, or high predation pressure by zooplankton. To compare the trophic degree of lakes lying at different latitudes, the pattern of solar radiation and temperature should be considered, in addition to nutrient loading. Results from a study carried out from 1969 to 1980 on the small alpine lake Monate (Northern Italy) show the difficulties involved in assessing the trophic degree of a lake and identifying the causes of its evolution. (Collier-IVI)
W85-02328

CHEMICAL CONTENT OF SNOW AND EFFECT OF MELTING ON CASCADE MOUNTAIN LAKES,
Washington Univ., Seattle. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W85-02329

MINIMAL MODEL OF EUTROPHICATION IN FRESHWATER ECOSYSTEMS,
Akademiya Nauk SSSR, Moscow.
A. A. Voinov, and Y. M. Svirezhev.
Ecological Modelling, Vol. 23, No. 4, p 277-292, July, 1984. 6 Fig, 15 Ref.

Descriptors: *Eutrophication, *Model studies, *Tophic level, Phytoplankton, Detritus, Nutrients, Dissolved oxygen, Reservoirs.

A very simple model of eutrophication is presented. It includes several quite aggregated parameters and can be studied by analytical methods. Nevertheless, its dynamic behavior reflects well real reservoir evolution as observed under the impact of increasing biogenic pollution. Such models, simple in construction but sensitive to the main trends of an ecosystem, are termed 'minimal'. The state variables in the model are the concentrations of: (1) phytoplankton; (2) biogenic elements (nutrients); (3) detritus; and (4) dissolved oxygen. Transformations among the substances are described by a system of four ordinary differential equations. Steady-state dynamics are studied (the so-called quasi-stationary process). The qualitative analysis undertaken shows that the total amount of substances in a reservoir (phytoplankton + detritus + nutrients) is a very important ecosystem control parameter. In fact, it is this parameter that determines the rate and the degree of eutrophication. It also turns out that the relations between some observed characteristics of the ecosystem may define beforehand the future behavior of the reservoir. (Author's abstract)
W85-02339

SALT LAKES AND THEIR ORIGINS IN XINJIANG, CHINA (IN CHINESE),
Qinghai Inst. of Salt Lake, Xining (China).
X. Zheng.
Oceanologia et Limnologia Sinica, Vol. 15, No. 2, p 168-178, 1984. 8 Fig, 5 Tab, 8 Ref.

Descriptors: *Saline lakes, *Xinjiang, *China, Brine, Minerals, Geology, Paleogeography, Chemical composition.

This paper, based on field data and experimental results, is intended to analyze and summarize the distribution, chemical composition of brines, groups of salt minerals, types and salt forming characteristics of the Xinjiang salt lakes. Evolution of the salt lakes and salt-forming regularities as seen from analysis of paleogeography environment, geological tectonic and substance origins and so forth are also reported. This paper will serve as a reference for further investigation of the Xinjiang salt lakes, as well as for comprehensive utilization of their resources. (Author's abstract)
W85-02383

THRESHOLD ODOUR CONCENTRATIONS OF ODOROUS ALGAL METABOLITES OCCURRING IN LAKE WATER,
Helsinki Univ. (Finland). Dept. of Limnology.
For primary bibliographic entry see Field 5F.
W85-02389

STRUCTURE AND DYNAMICS OF ZOOPLANKTON COMMUNITIES, ALLIGATOR RIVERS REGION, N.T., AUSTRALIA,
Esso Australia Ltd., Sydney.
R. D. Tait, R. J. Shiel, and W. Koste.
Hydrobiologia, Vol. 113, p. 1-13, June, 1984. 9 Fig, 2 Tab, 23 Ref.

Descriptors: *Environmental effects, *Mine wastes, *Population dynamics, *Oxbow lakes, *Plankton, *Australia, Seasonal variation, Uranium, Alligator River, Magela Creek, Rotifers, Crustacea, Billabongs.

A two year study was made of the species composition dynamics of plankton and littoral microfauna of billabongs (ox-bows) on the Magela Creek in an area associated with the impact of mining and milling of uranium. This study was extended with a summary of seasonal fluctuations in water quality in the study area, a checklist of all taxa recorded in the zooplankton and examples of spatial and seasonal variation in the community composition. Magela Creek is an ephemeral tributary of the East Alligator River. The region receives 97% of its annual rainfall from October to May, during which the floodplain may be submerged to a depth of 2-3 meters. Between May and December the plain dries out progressively, concentrating aquatic life in the remaining billabongs. Extremely diverse plankton assemblages occur late in the wet season, with up to 80 taxa of rotifers and microcrustacea in some billabongs while there is a decrease in diversity but increase in population density as the dry season progresses. Natural fluctuations in water quality may be extreme, and limiting to plankters common elsewhere in the tropics. The plankton is composed largely of littoral or epiphytic taxa, with endemic species in all groups. (Baker-IVI)
W85-02405

ZOOPLANKTON ASSOCIATIONS IN THE SWAMPS OF SOUTHERN SUDAN,
Westfield Coll., London (England). Dept. of Zoology.
J. Green.
Hydrobiologia, Vol. 113, p 93-98, June, 1984. 1 Fig, 1 Tab, 7 Ref.

Descriptors: *Zooplankton, *Swamps, *Sudan, *Lake Ambadi, Nile, Channels, Crustacea, Floodplains, Population density, Lakes.

Samples were collected from 24 sites in the swamps of southern Sudan. Samples taken in the main Nile channel yielded a poor zooplankton, deficient in species and heavily laden with organic debris. A richer zooplankton population was found in the side arms and floodplain lakes. Frequently these samples contained 15-20 species of rotifers and 10 or more species of Crustacea. With heavy vegetation on the foodplain lakes, the number of species increases. For the Crustacea the index of diversity normally varied between 0.6 and 2.4, but in a side arm of the Bahr el Zeraf it reached 6.1 and in Lake Ambadi on the Bahr el Ghazal it reached 8.4. Rotifer diversity was somewhat higher, normally ranging between 2 and 4.5, but reaching 23 in Lake Ambadi. The most diverse population of zooplankton was found at Lake Ambadi; however, the density of zooplankton in this lake was small due to a nutrient deficiency combined with low pH. (Baker-IVI)
W85-02406

ATTEMPT AT ECOLOGICAL PROGNOSIS OF THE PLANKTON IN THE MAN-MADE LAKE PARANA MEDIO (CHAPETON TRANSECT), ARGENTINA,
Akademiya Nauk SSSR, Moscow. Inst. of Evolutionary Morphology and Animal Ecology.
N. N. Smirnov.
Hydrobiologia, Vol. 113, p 159-163, June, 1984. 1 Fig, 2 Tab, 13 Ref.

Descriptors: *Plankton, *Lakes, *Lake Parana Medio, *Argentina, Environmental effects, Algae, Vegetation, Population dynamics.

The projected man-made lake along 300 km of the Middle Parana in the Republic of Argentina will radically affect a large and unique biospheric complex. This man-made lake will be a very large and long ditch, having a maximum width of more than 40 km and steep left and right shores. The percentage of Copepoda and Cladocera is expected to increase and temperatures above the level of about 20 C at the water surface also contribute to the reproduction of the latter. At the available level of nutrients, namely about 1 mg nitrate/liter, green algae will flourish. The development of desmids will be favored by a pH shift below 7. The abundant development of aigae will also benefit by the increased water transparency and slow water movements. The zooplankton will mainly determine the existence of fishes and of the other preying animals of this level in the Parana Medio manmade lake. Extensive growths of periphyton on the great surface of uniquely long dams will harbor species of demersal plankton and crawling species of Chydoridae and Macrothricidae. The latter two will thus develop in abundance at about 500,000 sq m of concrete slopes overgrown by attached algae. The zooplankton of the vegetation will be confined to small area of macrophytes. (Baker-IVI)
W85-02407

TROPICAL LAKES - FUNCTIONAL ECOLOGY AND FUTURE DEVELOPMENT: THE NEED FOR A PROCESS-ORIENTED APPROACH,
Oslo Univ. (Norway). Zoological Inst.
J. P. Nilssen.
Hydrobiologia, Vol. 113, p. 231-242, June, 1984. 6 Fig, 3 Tab, 61 Ref.

Descriptors: *Tropical regions, *Lakes, *Fish, *Plankton, Population dynamics, Eutrophication, Fungus, Bacteria, Seasonal variation, History.

Tropical lakes may be divided into several major classes including shallow, lowland lakes; deep, tertiary lakes; high altitudinal lakes; rainforests lakes; and man-made lakes at all latitudes and altitudes. Grazing, competition, predation, abiotic adaptation and other ecological processes are similar in temperate and tropical lakes. The structure of the areas of adaptative radiation and the dispersal ability of the species are important for the present distribution of taxa. Fish play a key role in the tropics since many species both consume zooplankton and compete with them for algal and pelagic sestonic food. Diurnal patterns in habitat selection of fish may also influence nutrient re-distribution in the tropics as in many temperate lakes. Eutrophication, clear-cutting of the rain forest, unwise introduction of new species not adapted to prevailing conditions, overfishing, extensive use of biocids, and probably acidic rain in areas with poorly buffered waters are problems which threaten tropical lakes. Co-evolution of fish and algae should be investigated further as it may in part explain the general scarcity and simplicity of the zooplankton community. Limnocorral experiments should also be used for further assessing processes in tropical lakes. (Baker-IVI)
W85-02408

INFLUENCE OF PREDATION BY FISH AND WATER TURBIDITY IN A DAPHNIA GESSNERI POPULATION IN AN AMAZONIAN FLOODPLAIN LAKE, BRAZIL,

Museu Paraense Emilo Goeldi, Para (Brazil). Dept. de Zoologia.
M. L. Carvalho.
Hydrobiologia, Vol. 113, p 243-247, June, 1984. 2 Fig, 14 Ref.

Descriptors: *Zooplankton, *Population dynamics, *Turbidity, *Water level, *Lakes, Lago Grande, Rio Solimoes, Brazil, Daphnia, Floodplains.

The population behavior of Daphnia gessneri Herbst, 1967 in a floodplain lake of the lower Rio Solimoes was investigated between April 1979 and March 1980. Emphasis was placed on predation by the fish called tambaqui (Colossoma macropomum, Characidae), water level fluctuation and water transparency in Lago Grande. Zooplankton density samples were collected at two sites near midlake, where water depth and Secchi disc transparency were measured. Qualitative samples of zooplankton and fish collections were taken at several sites in the adjacent floodplain areas. A disappearance of D. gessneri during the low water period was noted and may be caused by intense predation by fish and low water transparency due to bottom sediments that are mixed throughout the water column by wind action. When the water level arose anew and transparency improved, D. gessneri appeared again in the stomach contents of C. macropomum. (Baker-IVI)
W85-02409

IMPACT OF ZOOPLANKTON STATUS ON THE MANAGEMENT OF LAKE KINNERET (ISRAEL),
Kinneret Limnological Lab., Tiberias (Israel).
M. Gophen.
Hydrobiologia, Vol. 113, p 249-258, June, 1984. 1 Fig, 3 Tab, 63 Ref.

Descriptors: *Lakes, *Zooplankton, *Management, *Lake Kinneret, *Israel, Population dynamics, Seasonal variation.

The summer ecosystem of Lake Kinneret is characterized as a steady state type in which the impact of the zooplankton-chain is of great importance. Increase of predation pressure on zooplankton by fish can disequilibriate the balanced trophic relations existing between a nannoplankton production and zooplankton grazing capacity. Such a situation can lead to organic accumulation as nannoplankton blooms, resulting in water quality deterioration. Recommendations include the reduction external nutrient load and regulation of fish populations by fishery policy and fish introduction. Fish regulation will call for intensive increase of S. galilaeus populations. This fish has a unique value in the market, can graze Peridinium efficiently and is a natural component of the ecosystem. Eliminating the introduction of S. aureus, a zooplankton feeder and suppressor of Sarotherodon galilaeus is encouraged plus eliminating the stocking of silver carp, an exotic fish with low commercial value, which feeds on zooplankton in summer and can be cultured more successfully in fish ponds. A reduction is sought in the bleaks population in the lake by increasing fishing pressure aimed at decreasing predation pressure on zooplankton. (Baker-IVI)
W85-02410

REVERSE WEATHERING IN THE CLOSED-BASIN LAKES OF THE ETHIOPIAN RIFT,
Massachusetts Inst. of Tech., Cambridge. Dept. of Earth and Planetary Sciences.
For primary bibliographic entry see Field 2K.
W85-02468

COLONIZATION AND RECOVERY OF LOTIC EPILITHIC COMMUNITIES: A METABOLIC APPROACH,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
L. L. Osborne.
Hydrobiologia, Vol. 99, No. 1, p 29-36, February, 1983. 3 Fig, 1 Tab, 23 Ref.

Descriptors: *Primary productivity, *Respiration, *Benthos, *Sheep River, *Alberta, Metabolism, Streams, Bacteria, Invertebrates, Periphyton, Substrates, Lotic environment.

Community respiration and net primary productivity measurements from precleaned and disturbed substrates of various sizes were collected to examine the colonization and recovery rates of lotic epilithic communities in situ. The study was conducted in an unperturbed reach of the Sheep River, Alberta. The lowest community respiration and primary production rates were recorded immediately following the artificial perturbation suggesting that both the autotrophic and heterotrophic system components were adversely affected. The natural responses of benthic communities to spring spates appears to be similar to the metabolic responses invoked by the artificial perturbation employed. The recovery of the autotrophic community was slower than the heterotrophic. Under similar envionmental conditions and availability of a colonizing pool, a 13-21 day recovery period would be required to attain a metabolic level similar to that which existed prior to the perturbation. The heterotrophic community component recolonizes sooner than the autotrophic component. The energy flow through epilithic communities appear to attain a stable level during the summer, and the duration of the metabolic equilibrium is dependent on constancy of the physical environment. (Baker-IVI)
W85-02476

PREDICTION OF SECCHI DISC DEPTHS IN FLORIDA LAKES: IMPACT OF ALGAL BIOMASS AND ORGANIC COLOR,
Florida Univ., Gainesville. Center for Aquatic Weeds.
D. E. Canfield, Jr., and L. M. Hodgson.
Hydrobiologia, Vol. 99, No. 1, p 51-60, February, 1983. 2 Fig, 6 Tab, 17 Ref.

Descriptors: *Secchi disks, *Model studies, *Florida, *Lakes, Chlorophyll, Color, Turbidity, Algal growth, Eutrophication, Transparency.

A model for the prediction of Secchi disc depths in Florida lakes was developed and tested using data from 205 lakes. Between August 1979 and September 1980, the lakes were sampled three times to determine chlorophyll a concentration, color concentration, and Secchi disc depths. A strong hyperbolic relationship was noted between lake transparencies as measured by use of the Secchi disc and algal biomass as measured by chlorophyll a concentrations. For the sampled lakes, 38% have chlorophyll a values above 10 mg/cu m and 55% have organic color values above 30 mg/cu m. As a result, 66% have Secchi disc depths below 2 m. To assist Florida lake managers, a quantitative empirical model which could be used to predict Secchi disc depths given various chlorophyll and/or color concentrations was developed to determine which variables should be used in the final model and whether the relationships between lake transparency, chlorophyll a and color concentrations were linear or nonlinear. It is believed the model will be applicable to lakes outside of Florida as chlorophyll and color concentrations should affect lake transparency similarly. The model will not work in lakes that have significant concentrations of inorganic sediments. To significantly reduce the remaining error term, a term for nonalgal turbidity, and most likely a term for inorganic suspended sediments needs to be incorporated into the model. (Baker-IVI)
W85-02477

LIMNOLOGICAL STUDIES ON THE PRETORIA SALT PAN, A HYPERSALINE MAAR LAKE,
National Inst. for Water Research, Pretoria (South Africa).
P. J. Ashton, and F. R. Schoeman.
Hydrobiologia, Vol. 99, No. 1, p 61-73, February, 1983. 8 Fig, 2 Tab, 46 Ref.

Descriptors: *Limnology, *Pretoria Salt Pan, *South Africa, *Maar lakes, Chemical properties, Drainage basins, Saline lakes, Stratification, Hydrologic budget.

The Pretoria Salt Pan is shallow, having a maximum depth of 2.85 m, and alkaline with surface water pH varying from 9.6 to 10.9. Pronounced mesothermy (38.2 C in spring) occurs at a depth between 0.55 and 0.7 meters. The water budget of the lake is governed by evaporation, precipitation and the inflow of spring water. The artesian spring located at the end of the promontory was the only source of inflowing water, other than direct rainfall and surface runoff. Secchi disc transparencies ranged from 7 to 19 cm. A total ionic concentration gradient increased from 59,500 mg/l near the surface to 298,000 mg/l at 2.75 meters, stabilizing the thermally inverted water column. The major cation was sodium and nearly equal proportions of chloride plus carbonate and bicarbonate accounted for over 98% of the anions. Higher concentrations of most elements occurred shortly after heavy rainfall in the surrounding area and lowest values were recorded towards the end of winter when inflows were lowest. The lake was meromictic with a steep chemocline, persistent thermally inverted temperature profile and complete anoxia at depths greater than 50 cm. The diel pattern of dissolved oxgyen distribution involving a nocturnal deoxygenation and diurnal reoxygenation was unusual. (Baker-IVI)
W85-02478

DETECTION WITH THE AID OF A BIOASSAY (SELENASTRUM CAPRICORNUTUM) OF THE EFFECTS OF A MINE WASTE ON THE AQUATIC ENVIRONMENT: TOXICITY OR ENRICHMENT OF ESSENTIAL SUBSTANCES (DETECTION A L'IDE D'UN BIO-ESSAI (SELENASTRUM CAPRICORNUTUM) DES REPERCUSSIONS D'UN REJET MINIER SUR L'ENVIRONNEMENT AQUATIQUE: TOXICITE OU ENRICHISSEMENT EN SUBSTANCE ESSENTIELLE),
Department of the Environment, Hull (Quebec).
C. Blaise, and P. Couture.
Hydrobiologia, Vol. 114, No.1, p 39-50, July, 1984. 2 Fig, 7 Tab, 29 Ref.

Descriptors: *Mine wastes, *Water pollution effects, *Nutrients, *Quebec, Bioassays, Algal growth, Turbidity, Suspended solids, Nitrogen, Phosphorus, Heavy metals, Dissolved solids.

Physical and chemical studies and algal bioasays were conducted to assess the effects on waterways receiving the treated effluent wastes of an iron ore mining operation located in north-eastern Quebec, Canada. Initial data interpretation indicates that the area directly below the outfall of the mining effluent (Hesse Lake and Webb Creek) is the most perturbed and that this condition diminishes for stations located further downstream. For Hesse Lake, in particular, high values of conductivity, turbidity, suspended solids, nitrate + nitrite nitrogen, phosphorus and algal growth potential were reported. Nitrate + nitrite nitrogen levels observed in the aux Pekans River system are the result of high levels present in Hesse Lake and Webb Creek. A more elaborate analysis, based on an evaluation of algal phosphorus uptake obtained with bioassays, indicates that apparent toxicity noticed in a few samples is probably due to the unavailability of essential elements other than phosphorus or nitrogen. This toxicity is accounted for by trace metal unavailability due to complex formation by organic matter. Cautious interpretation of results is recommended when using algal bioassyas in order to distinguish between possible interacting effects of growth-limiting essential elements and the presence of toxic substances. (Baker-IVI)
W85-02480

TEMPORAL AND SPATIAL DISTRIBUTION OF ROTIFERA IN A CHILEAN RESERVOIR: A POSSIBLE EFFECT OF IMPOUNDMENT HYDRODYNAMICS,
Chile Univ., Santiago. Dept. de Biologia.
D. Soto, I. Vila, and B. Villalobos.
Hydrobiologia, Vol. 114, No. 1, See also W85-02480, W85-02472, p 67-74, July, 1984. 6 Fig, 2 Ta, 27 Ref. Grants SCRP 551-381 and MAB 5 UNESCO.

Descriptors: *Rotifers, *Chile, *Rapel Reservoir, *Temporal distribution, *Spatial distribution, *Reservoirs, Population dynamics, Seasonal variation, Dam effects.

Rotifers were sampled at monthly intervals for a year a four monitoring stations in Rapel Reservoir. This reservoir lies in central Chile and was formed when a hydroelectric dam was built on the river in 1960. It is a monomictic and temperate lake which displays a dendritic shape and covers an area of about 137.5 sq km, with a distance of 40 km from major influent rivers to the dam. Maximal discharge to the lake occurs in the summer following snow melt in the Andes. Flow in the Tinguiririca River depends more on rainfall reaching the maximum in the winter. Thus the reservoir has two main periods of water inflow. Fifteen species of rotifers were identifed, but only Keratella cochlearis was consistently found at each station. It was also in most cases the most abundant totalling more than 50% of the rotifer population. Sampling stations nearest the dam showed greatest rotifer densities in spring and autumn; those nearest the in flowing rivers had highest abundance in summer. The impoundment water dynamics and the relative locations within the lake are suggested as determinants for different rotifer assemblages and probably for most other planktonic organisms. (Baker-IVI)
W85-02481

LONG-TERM CHANGES OF THE SUBMERGED MACROPHYTES IN EUTROPHIC LAKE MIKOLAJSKIE (NORTH POLAND),
Warsaw Univ. (Poland). Dept. of Hydrobiology.
For primary bibliographic entry see Field 5C.
W85-02483

HYDROBIOLOGICAL RESEARCH ON TWO SMALL BRACKISH LAKES IN PORTONOVO; I: LAKE PROFONDO (RICERCHE IDROBIOLOGICHE SU DUE LAGHETTI DI PORTONOVO; PARTE I: LAGO PROFONDO),
Perugia Univ. (Italy). Ist. di Idrobiologia e Pescicultura.
For primary bibliographic entry see Field 5C.
W85-02499

HYDROBIOLOGICAL RESEARCH ON TWO SMALL BRACKISH LAKES IN PORTONOVO; II: LAKE GRANDE (RICERCHE IDROBIOLOGICHE SU DUE LAGHETTI DI PORTONOVO; PARTE II: LAGO GRANDE),
Perugia Univ. (Italy). Ist. di Idrobiologia e Pescicultura.
For primary bibliographic entry see Field 5C.
W85-02500

TOTAL PHOSPHORUS LOAD TO LAKE MONATE (NORTHERN ITALY, VARESE) (STIMA DEL CARICO DI FOSFORO TOTALE AL LAGO DI MONATE (PROVINCIA DI VARESE, ITALIA SETTENTRIONALE)),
Commission of the European Communities, Ispra (Italy).
For primary bibliographic entry see Field 5B.
W85-02501

HISTORICAL AND CURRENT LIMNOLOGICAL RESEARCH IN THE SMALL RIVER LINDE, THE NETHERLANDS,
Department of Public Works, Leeuwarden (Netherlands).
T. H. L. Claassen.
Hydrobiological Bulletin, Vol. 18, No. 1, p 23-34, June, 1984. 4 Fig, 4 Tab, 27 Ref.

Descriptors: *Limnology, *River Linde, *Netherlands, Streams, Chemical properties, Physicochemical properties, Seasonal variation, Chloride, Iron, Phosphorus, Nitrogen.

Existing and newly collected limnological data of the Linde, a stream in the southeastern part of Friesland, are detailed. An overview of the available water quality data is presented along with historical data. The resemblance is striking between older water quality data and recent ones. A period of 20 years with regard to chemical data and about 10 years with regard to biological data is considered. There is a periodicity of various water quality parameters during the period of a year. The discharge of superfluous water in winter coincides with low chloride and high iron, phosphorus and nitrogen concentrations of the water. The spatial diversity between parts of the stream is described. Three main reaches could be distinguished, the upper, middle and lower course, each with their own physicochemical and biological characteristics. When setting ecological water quality standards this division should be taken into account. Not only the stream biocoenoses themselves must be regarded, but also the surrounding peat areas and the downstream shallow lakes. These water are, among others, dependant on the water quality of the Linde. (Baker-IVI)
W85-02503

RESISTANCE TO MIXING IN NEW ZEALAND LAKES,
Department of Scientific and Industrial Research, Taupo (New Zealand). Taupo Research Lab.
A. B. Viner.
New Zealand Journal of Marine and Freshwater Research, Vol. 18, No. 1, p 73-82, 1984. 7 Fig, 1 Tab, 17 Ref.

Descriptors: *Lakes, *Stratification, *Mixing, *New Zealand, Stability, Morphology, Wind, Algae, Light, Thermal stratification, Phytoplankton.

Illustrations are offered of the way in which stability calculations can help towards reducing limnological problems. A graph and equation are given which relate New Zealand lakes through their stabilities. Stability is defined as the amount of energy required to mix a thermally stratified column of water to isothermy. Lake stability calculations quantify the resistance a column of water has to vertical mixing. Date from a selection of New Zealand lakes have been used to show a predictive relationship between the seasonal maximum stability and mean depth. Because of their proportionality, seasonal maximum stability can be substituted for the total annual stability for the purposes of lake comparisons, although total stability would be a better ecological parameter if enough data were available. Stability calculations in the euphotic zones of lakes enable useful comparisons to be made regarding growth conditions for different types of phytoplankton, in particular buoyant cyanophytes, and especially in relation to light penetration. An example is given where the degree of thermal stratification (stability) could be related to wind stress energy. (Baker-IVI)
W85-02507

EPIPELIC ALGAE IN MARGINAL PARTS OF THE PRZECZYCE RESERVOIR AND OF NEIGHBOURING SECTORS OF THE RIVER CZARNA PRZEMSZA (UPPER SILESIA); 1. ALGAE IN CONSTANTLY SUBMERGED ZONE,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
D. Sieminiak.
Acta Hydrobiologica, Vol. 25/26, No. 1, p 51-66, 1983/1984. 1 Fig, 2 Tab, 10 Ref.

Descriptors: *Algal growth, *Reservoirs, *Przeczyce Reservoir, *River Czarna Przemsza, *Upper Silesia, *Poland, Population dynamics, Water quality.

In the years 1977 and 1978 investigations were carried out on the bottom living algae in the reservoir and in the river just above and below it. The algal communities studied may be said to be fairly varied, since altogether (apart from diatoms) about 180 taxa were identified. Although only certain of the species occurred in large numbers both in the river and in the reservoir, they were accompanied, particularly in the reservoir, generally in very small quantities, by a variety of algal species from various systematic groups, principally Cyanophyta, Chlorococcales, Mesotaeniales, Desmidiales, Euglenales, and Xanthophyceae, which are typical of the littoral of still water reservoirs. Such bottom-living algal communities are characterisic of unpolluted waters. The presence of the red alga Batrachospermum moniliforme in the Czarna Przemsza river below the reservoir is noted which indicates that the water outflowing from the reservoir is relatively pure. (Baker-IVI)
W85-02522

THROUGHFLOW INVESTIGATIONS IN 'VORDERER FINSTERTALER SEE' (TYROL) BY URANIN DYE (DURCHFLUSSUNTERSUCHUNGEN AM VORDEREN FINSTERTALER SEE (KUEHTAI, OSTERREICH) MIT URANINFAEBVERSUCHES),
For primary bibliographic entry see Field 2E.
W85-02524

BIOMASS AND PHOSPHORUS-CONTENT OF THE MACROPHYTES OF THE NE-BAY OF THE LUNZER UNTERSEE (AUSTRIA) IN RELATION TO NUTRIENT-RICH INFLOWS AND TO THE SEDIMENT (BIOMASSE UND PHOSPHORGEHALT DER MAKROPHYTEN IN DER NO-BUCHT DES LUNZER UNTERSEES (AUSTRIA) IN ABHANGIGKEIT VON NAHRSTOFFREICHEN ZUFLUSSEN UND VOM SEDIMENT),
Oekologische Station Waldviertel, Schrems (Austria).
G. Schlott, and G. Malicky.
Archiv fur Hydrobiologie, Vol. 101, No. 1/2, p 265-277, August, 1984. 2 Fig, 13 Tab, 11 Ref.

Descriptors: *Macrophytes, *Phosphorus, *Bays, *Nitrogen, *Lunzer Untersee, *Austria, Aquatic plants, Nutrients, Lake sediments, Biomass.

Macrophytes were studied in a part of the Lunzer Untersee with respect to their biomass and phosphorus content. Both the biomass and the phosphorus content of macrophytes showed big differences depending on the nutrient supply. Inlets with high nutrient transport and also places of diffuse inflow increase the biomass and the phosphorus-content of the plants. For comparison it is necessary to investigate plants from unpolluted sites of the same water body. In the Mayrbucht the different nutrient supply of different areas is associated with different values in the sediment. The differences of phosphorus are essentially higher than those of nitrogen. The comparison of the N/P-ratio in the macrophytes with the sediment-phosphorus will show the limiting role of the phosphorus. (Baker-IVI)
W85-02527

STRATIFICATION OF THE KOENIGSSEE (BAVARIA, GERMANY) (DIE SCHICHTUNGSVERHALTNISSE DES KOENIGSSEES),
Munich Univ. (Germany, F.R.). Zoologisches Inst.
O. Siebeck, and R. Muller.
Archiv fur Hydrobiologie, Vol. 101, No. 1/2, p 289-301, August, 1984. 9 Fig, 2 Tab, 6 Ref.

Descriptors: *Lakes, *Water circulation, *Koenigssee Lake, *Germany, Circulation, Seasonal variation, Eutrophication.

Due to its morphometrical and meteorological properties, water circulation in the Koenigssee is poor. Circulation, while possible from December to March, will not occur it the lake becomes ice-covered. Even so, it will mix only in a layer down about 20 m from the surface. Vertical water exchange becomes very limited between 20 and 140 m. At depths greater than 140 m, vertical water exchange is very poor, causing the lake to exhibit tendencies toward monimolimnion. This meromixis is of biogenic origin. In the lake a monimolimnion would occur in a very early stage of eutrophication, if measures are not taken to prevent sewage inflows caused by growing tourism. (Baker-IVI)
W85-02528

DEVELOPMENT OF OXYGEN CONDITIONS IN LAKE ZURICH FROM 1936 TO 1982 (ENTWICKLUNG DER SAUERSTOFFVERHALTNISSE IM ZURICH-OBERSEE UND IM ZURICH-UNTERSEE VON 1936 BIS 1982),
Zurich Univ., Kilchberg (Swizerland). Hydrobiological-Limnological Station.
E. A. Thomas, and C. G. Orn.
Archive fur Hydrobiologie, Vol. 101, No. 1/2, p 327-342, August, 1984. 5 Fig, 2 Tab, 12 Ref.

Descriptors: *Dissolved oxygen, *Lake basins, *Lake Zurich, *Switzerland, Hypolimnion, Phosphates, Water pollution effects, Water pollution control.

Two separate basins are found in Lake Zurich. The Upper Lake Zurich has a maximum depth of 48 m and the Lower Lake has a depth of 136 m. Oxygen profiles were obtained monthly from both basins and evaluated. Based on the course of the annual hypolimnetic oxygen minimum, the 47 yr covered in the data file may be divided into three intervals. The annual minimum between 20 m depth and the bottom of the lake decreased at Altendorf from 5.69 mg/l to 2.14 mg/l. In the Lower Lake the annual minimum in 100-136 m depths initially worsened from 2.24 mg/l to 1.19 mg/l, but then strongly improved to 3.54 mg/l. Hypolimnetic oxygen conditions in the Lower Lake have recovered, whereas the annual oxygen minima in the Upper Lake still underlie a deteriorating trend. The conspicuous improvement observed since 1967 in the Lower Lake is primarily due to the purposeful steps taken to eliminate sewage phosphates. Within the drainage area of the Upper Lake however, sewage treatment measures are still inadequate. (Baker-IVI)
W85-02529

LIMNOLOGY AND PLANKTON PERIODICITY OF JOS PLATEAU WATER RESERVOIR, NIGERIA, WEST AFRICA,
Jos Univ. (Nigeria). Dept. of Botany.
M. A. Khan, and C. Ejike.
Hydrobiologia, Vol. 114, No. 3, p 189-199, July, 1984. 6 Fig, 2 Tab, 35 Ref.

Descriptors: *Limnology, *Plankton, *Reservoirs, *Lamingo Dam, *Nigeria, Dissolved oxygen, Water temperature, Diel variation, Water chemistry.

Limnological data are presented concerning the plankton and water chemistry of Lamingo Dam, located within the Jos biotite granite area of the Plateau State (Nigeria). The water body falls into Beadle's category I of African lakes. The conductivity is less than 40 microS/cm. The low specific conductance indicates a low ionic content. Total alkalinity was due primarily to bicarbonate ions and it varied from 0.23 to 0.44 meg/l. Variations in dissolved oxygen were noticeable with higher values recorded for cold dry periods. The surface water temperature varied from 16 to 24 C, low temperatures generally prevailing during December and early February. Plankton were characterized by a moderate standing crop of phytoplankton, and zooplankton were, generally, very limited in species and abundance. A diel cycle was characterized by nocturnal upward migration of the zooplankton, and the reverse behavior in the phytoplankton. (Baker-IVI)
W85-02546

ASPECTS OF THE ECOLOGY OF THE FISHES OF HOLYROOD POND: A COASTAL LAKE WITH OCCASIONAL ACCESS TO THE SEA LOCATED IN ST. MARY'S BAY, NEWFOUNDLAND,
Memorial Univ. of Newfoundland, St. John's.
M. F. O'Connell, C. W. Andrews, J. P. O'Brien, and E. G. Dawe.
Internationale Revue der Gesamten Hydrobiologie, Vol. 69, No. 3, p 333-360, 1984. 15 Fig, 9 Tab, 62 Ref.

Descriptors: *Ponds, *Fish, *Holyrood Pond, *Newfoundland, *St. Mary's Bay, Seasonal variations, Temperature, Brackish water, Oxygen, Fish populations, Physical properties, Chemical properties.

Physical and chemical conditions and fish were studied during spring and summer in 1974 and 1975 in Holyrood Pond, Avalon Peninsula, Newfoundland. Holyrood Pond is a body of salt water which is landlocked for the greater part of the year. In order to alleviate flooding of waterfront property and highway erosion problems the barrier, composed of beach material that isolates the pond from St. Mary's Bay set in place by southwest winds and wave action, is opened in spring and early summer by bulldozer. When the barrier is closed, individual salinity and temperature profiles resemble those described for meromictic lakes. During the open barrier phase, the pond comes under tidal influence and behaves like a fjord. A total of 30 species of fish was encountered in the pond throughout the investigation. The trout sample consisted of a mixture of the anadromous and nonanadromous forms. Maximum length and age of cod are much lower than reported for the offshore populations. The same applies to white hake. Winter flounder growth on the other hand is very good compared with other areas. (Baker-IVI)
W85-02563

INTERACTIONS BETWEEN PHYTOPLANKTON, ZOOPLANKTON, AND FISH IN THE NUTRIENT RICH SHALLOW LAKE HJARBAEK FJORD, DENMARK,
Vandkvalitetsinstitutet, Hoersholm (Denmark).
K. Olrik, S. Lundoer, and K. Rasmussen.
Internationale Revue der Gesamten Hydrobiologie, Vol. 69, No. 3, p 389-405, 1984. 6 Fig, 5 Tab, 27 Ref.

Descriptors: *Nutrients, *Phytoplankton, *Zooplankton, *Fish, *Hjarbaek Fjord, *Denmark, Ammonia, Nitrogen, Seasonal variation, Algal growth, Population dynamics, Acidity, Daphnia, Copepods.

The seasonal periodicity of phytoplankton, zooplankton, fish and water chemistry, and the interrelationship between these variables, were examined in the nutrient rich, dammed up, shallow and slightly brackish lake Hjarbaek Fjord in North Jutland, Denmark. During the summer the balance between the various levels of the pelagic food chain in the lake was completely disturbed. Extensive growth of small fast-growing bluegreen algae and chlorococcal green algae caused by high nutrient levels induced a rise in pH to 10.5 in July. This extreme pH-rise drove the fish into the rivers and caused the death of those that did not escape. The slow-moving Daphnia hyalina, which was heavily predated upon by fish, multiplied explosively after the fish had disappeared, and almost completely grazed away the phytoplankton biomass consisting mainly of chlorococcal green algae and small bluegreen algae. The pH then became stabilized at 8.0, but ammonia concentrations rose to noxious levels for fish and the oxygen concentration dropped to below 6 mg/l, a level which is noxious to highly sensitive fish. A smaller maximum of large phytoplankton species occurred during the Daphnia maximum and gave rise to a maximum of the copepod Cyclops strenuus, which can actively grasp and divide larger phytoplankton species. Fish returned to the lake in October, when pH levels and concentration of ammonia, phosphorus and oxygen, had normalized. (Baker-IVI)
W85-02564

ORGANIC CARBON IN A EUTROPHIC FISHPOND,
Ceskoslovenska Akademie Ved, Prague. Hydrobiologicka Lab.
P. Blazka, and L. Prochazkova.
Internationale Revue der Gesamten Hydrobiologie, Vol. 69, No. 3, p 429-441, 1984. 7 Fig, 5 Tab, 44 Ref.

Descriptors: *Scenedesmus, *Organic carbon, *Eutrophic lakes, *Velky Farsky, *Czechoslovakia, Chlorophyta, Chlorophyll, Spectrophotometry, Algae, Chromatography, Cation exchange.

The concentration of dissolved organic carbon (DOC) in a eutrophic fishpond (Velky Farsky - located near the village of Belice, Czechoslovakia) was significantly correlated with chlorophyll a concentration and increased during the growing season. Samples of pond water and Scenedesmus abundans culture media were treated with a cation exchanger in Na cycle and chromatographed on Sephadex G 25 and G 10. The culture media was of similar ionic composition to the pond water. UV and VIS spectra of the peak fractions showed no absorbance maxima between 210 and 300 nm. In the pond about half of the organic carbon is in fractions with an apparent molecular weight (AMW) of 500-1000, while in the algal medium (after cultivation) most of organic carbon has an AMW of about 120. The spectral data, DOC analyses, and elution volume of the peak fractions suggest that substituted aromatics and aliphatic compounds with conjugated chromophoric groups play a minor role as constituents of DOC in pond water (Collier-IVI)
W85-02566

POTENTIAL MOBILITY OF PHOSPHORUS IN DIFFERENT TYPES OF LAKE SEDIMENT,
Uppsala Univ. (Sweden). Limnologiska Institutionen.
B. Bostrom.
Internationale Revue der Gesamten Hydrobiologie, Vol. 69, No. 4, p 457-474, 1984.

Descriptors: *Phosphorus, *Sweden, *Lakes, *Lake sediment, Physicochemical analysis, Chemical analysis, Hydrogen ion concentration, Trophic level, Aluminum, Iron, Nutrients.

Internal loading of phosphorus from sediments often leads to maintenance of high trophic levels in lakes after drastic reductions of nutrient inputs. An approach for determining the prerequisites for internal phosphorus loading from different sediments is to analyze the fractional distribution of the sedimentary phosphorus and to then determine the proportion that is potentially mobile within the naturally occurring range of variation for the most important environmental factors. The fractional composition and potential mobility of sediment phosphorus was investigated in nine Swedish lakes with different characteristics. Differences between sediments regarding P release patterns in laboratory experiments with varying pH and redox conditions could largely be explained by differences in the fractional composition of the sedimentary P. Sediments from sewage-loaded lakes contained considerably more loosely adsorbed P than unpolluted lakes. P release was redox-sensitive and strongly favored by high pH values in sediments with a high content of aluminium and iron-bound P. Other sediments released primarily organic and loosely adsorbed P, and in such cases less P was released and redox and pH conditions had less effect. For most sediments, the release rates measured in the laboratory were similar to those determined from mass balance calculations for the lakes. (Collier-IVI)
W85-02567

INTERACTIONS BETWEEN LIGHT SITUATION, DEPTH OF MIXING AND PHYTOPLANKTON GROWTH DURING THE SPRING PERIOD OF FULL CIRCULATION,
Technische Univ., Dresden (German D.R.).
H. Horn, and L. Paul.
Internationale Revue der Gesamten Hydrobiologie, Vol. 69, No. 4, p 507-519, 1984. 3 Fig, 4 Tab, 28 Ref.

Descriptors: *Lake Saidenbach, *Germany (Democratic Republic), *Mixing, *Phytoplankton, *Water circulation, Photosynthesis, Seasonal variation, Lakes, Biomass, Productivity, Solar radiation.

In mesotrophic Lake Saidenbach (German Democratic Republic), with maximum depth of 45 m and a mean depth of 15.35 m, vigorous growth of the phytoplankton does not start until after the onset of the spring complete circulation, and the end of the circulation period very often coincides with the beginning of the decline of the mass development (usually Asterionella formosa). The poor light situation and the fact that vertical phytoplankton profile shows significant differences between the plankton concentrations at different depths indicate that the spring complete circulation does not represent a complete recirculation, and thus mixing, of the water down to the bottom but involves only episodic and local partial recirculations interspersed with periods of relatively slight turbulence. The actual mixing depth during this period of complete circulation is therefore obviously less than the mean depth of the water concerned, which is commonly assumed to be equal. This permits the algae in the upper layers to grow.

Respiratory losses of the phytoplankton at greater depths probably remain slight due to their adaptation to low light intensities in winter. Using values reported in the literature for the minimum daily radiation permitting development of the phytoplankton, a maximum possible mean mixing depth of 12 m was calculated for the lake during the spring complete circulation; this is about 78% of the mean depth. (Collier-IVI)
W85-02568

INTERNAL SEICHE AND WAVES IN LAKE CHUZENJI (JAPAN),
National Inst. for Environmental Studies, Tsukuba (Japan).
T. Hirata, and T. Muraoka.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No.1, p 91-96, July, 1984. 7 Fig, 1 Tab, 6 Ref.

Descriptors: *Lake Chuzenji, *Japan, *Lakes, *Waves, *Seiches, Limnology, Thermocline, Mixing, Stratification, Wind, Hydrostatic pressure.

Lake Chuzenji is located in the Nikko National Park, about 100 km north from Tokyo. The lake is about 6.54 km in length and 1.85 km in width, with a mean depth of 94.7 m. When the wind blew over the lake for a reasonably long time, the surface mixing layer deepened eventually toward the leeward area. The wind action was effective only to break the isotherms near the surface and had little impact on the thermocline. The model of the hydrostatic pressure proposed can provide a reasonable estimation for the increase of the surface mixing layer over the thermocline. When the wind forcing was completely excluded, the oscillation of the thermocline was noted in periods of 12 hours and in other shorter periods of time. The 12 hour periods were generated by the uninodal internal seiche, and the latter was determined to be the typical Brunt-Vaisala wave of which wavelength is the same magnitude of the thermocline thickness. (Baker-IVI)
W85-02605

MID-SUMMER MIXING DEPTHS OF LAKES OF DIFFERENT LATITUDES,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
K. Patalas.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 1, p 97-102, July, 1984. 5 Fig, 19 Ref.

Descriptors: *Fetch, *Lakes, *Mixing, *Latitudinal studies, *Mixing, Canada, Cyclin, nutrients, Limnology, Elevation, Water temperature, Climate, Topography.

The possibility that mixing depth might be predicted from simple morphometric measurement in a wide variety of lakes was examined. The epilimnion depths in 23 lakes in the Yukon and Yellowknife areas generally displayed a similar trend with fetch, although the range of mixing depths was wider than in lakes south of 59 degrees N. The wider range of epilimnion depths in these northern lakes could be explained by their wider range of elevations. Several Canadian lakes situated in lower latitudes between 42 degrees and 51 degrees N have been plotted against the regression line. Nineteen lakes in Quebec, Ontario and Manitoba, with fetches shorter than 15 km, closely followed the trend described for Polish and Central Canadian lakes. Seventeen of these fell within the 0.95 confidence limits. Their mid-summer temperatures were usually within the 20-23 C range. Greater deviation was found for some lakes of Nova Scotia and New Brunswick for the 54-59 degree N regression. The similar mixing depths of lakes in such remote latitudes, from 35 to 65 degrees N, indicates that the size of a lake as expressed by its fetch is the most significant factor defining the extent of mixing. Factors such as latitude dependent temperature, continental or oceanic climates and the surrounding topography can modify the mixing depth from 10 to 30% from values predicted by the 54-59 degree N regression. (Baker-IVI)
W85-02606

AUTUMNAL AND VERNAL CIRCULATION OF SMALL FOREST LAKES IN SOUTHERN FINLAND,
Helsinki Univ., Lammi (Finland). Lammi Biological Station.
K. Salonen, L. Arvola, and M. Rask.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 1, p 103-107, July, 1984. 7 Fig, 1 Tab, 6 Ref.

Descriptors: *Forest watersheds, *Finland, *Meromictic lakes, *Water circulation, Seasonal variation, Lakes, Salinity, Thermal stratification, Color, Anoxic zone.

A systematic survey was made of 71 lakes to get an idea of the occurrence of meromixis among small lakes in Southern Finland. Most of the study lakes were forest lakes in the Evo lake district. Their size varied between 0.001 to 0.28 sq km and the color of water varied between 7 and 290 mg Pt/liter. The survey found meromixis, and in particular, spring meromixis, to be rather common among small forest lakes in Southern Finland. Apparently in the whole northern coniferous forest zone meromictic lakes are much more common than is generally believed. The lakes of this study differ from most other meromictic lakes in that they had no marked salinity gradient. In such cases temperature gradient was also significant in maintaining stratification. Therefore, the humic color of water, with its tendency to reduce mixing, is probably important for the occurrence of meromixis in small lakes. Equally important might also be the regularly found anoxic zone of small humic lakes, which may increase leaching of electrolytes into the hypolimnion. (Baker-IVI)
W85-02607

MEASUREMENT OF VERTICAL MOVEMENT OF LAKE WATER,
Rissho Univ., Tokyo (Japan). Dept. of Geography.
T. Arai.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 1, p 108-111, July, 1984. 3 Fig, 3 Ref.

Descriptors: *Water circulation, *Vertical flow, *Measuring instruments, *Lake Shibire, *Japan, Stratification, Temperature effects, Diurnal variation, Seasonal variation, Ultrasonic current meter, Heat flux.

The ultrasonic current meter (USCM) was designed to detect the vertical flow and calculate the vertical heat flux. While it can detect only the vertical flow (W), it is equipped with a temperature sensor. Thus the automatic calculation of vertical heat flux by eddy correlation method is possible by this USCM. Investigations were conducted in Lake Shibire, a small mountain lake in Central Japan with a typical closed form that lacks in- and out-flowing rivers. The maximum velocity was about 2 mm/sec in both summer and fall nights and within a range of 1 mm/sec normally. The vertical motion was mainly controlled by thermal stratification in the surface layer and air-water temperature difference. It is necessary to extend the investigation to wide and deep lakes which store a large amount of heat in the water column in summer and release it during fall overturn period, generating strong vertical flow. (Baker-IVI)
W85-02608

TEMPERATURE AND TRANSPORT PATTERNS IN LAKE TAHOE: SATELLITE IMAGERY, FIELD DATA AND A DYNAMIC MODEL,
California Univ., Davis. Div. of Environmental Studies.
T. Strub, T. M. Powell, and M. R. Abbott.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 1, p 112-18, July, 1984. 4 Fig, 11 Ref.

Descriptors: *Water circulation, *Lake Tahoe, *Temperature effects, Model studies, Satellite technology, Wind, Primary productivity, Water temperature, Gyre.

With the use of satellite images, in situ temperature sections, measured winds and a numerical wind driven model the mean spring and summer surface temperature structure was determined at Lake Tahoe. Typical afternoon south west winds cause upwelling on the west and in the south, and the accumulation of warm water on the east. Cold water from the west moves to the northeast and at least during some periods warm water from the east returns to the west in a large clockwise gyre which occupies the northern half of the open lake. The current pattern in the south is less clear and may be more variable due to winds that switch from northerly to southerly during the day, and have also been found to be more variable from day to day. Areas of warm water identify locations where water is blown against the shore; these indicate that the shoreline inflows in the northeast will not be dispersed as rapidly as inflows on the west side. Previous synoptic studies have found high levels of primary productivity in the northeast and southeast corner and it is suggested that inflowing water may be trapped against the coast there by the wind-driven currents. (Baker-IVI)
W85-02609

PARTICULATE MATTER DISTRIBUTION AND HEATING PATTERNS IN A SMALL POND,
Clemson Univ., SC. Dept. of Biological Sciences.
S. P. Schreiner.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 1, p 119-124, July, 1984. 2 Fig, 11 Ref.

Descriptors: *Particulate matter, *Phytoplankton, *Ponds, *Thermal stratification, Eutrophication, Seasonal variation, Turbidity, Light penetration.

Biotic and abiotic particulate layers associated with seasonal phytoplankton succession and thermal stratification significantly affect surface and internal heating patterns. These effects were studied in a small eutrophic 1.5 ha farm pond with a mean depth of 1.9 m. A submersible beam transmittance meter was used in conjunction with in situ measurements of standard physicochemical parameters to locate and study the development of phytoplankton and other types of layers. Measurements were made morning and afternoon twice weekly during the stratified period in 1982. Results indicate a rapid successional sequence of phytoplankton layers in April through June with subsequent development of a metalimnetic layer persisting from June until fall overturn in early October. Temperature measurements revealed intense heating in the near surface waters during periods of high surface turbidity and less intense heating to a greater depth when surface turbidity was lower. Greater rates of heating occurred near subsurface layers than in the overlying water, when surface turbidity was low enough to permit light penetration to the deeper layer. (Baker-IVI)
W85-02610

MODELING THE SEASONAL THERMAL DEVELOPMENT OF LAKE NANTUA (AIN, FRANCE) (MODELISATION DE L'EVOLUTION THERMIQUE SAISONNIERE DU LAC DE NANTUA (AIN, FRANCE)),
Institut National de la Recherche Agronomique, Jouy-en-Josas (France). Lab. de Biometrie.
F. Chahuneau.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 125-131, July, 1984. 2 Fig, 6 Ref.

Descriptors: *Lake Nantua, *France, *Seasonal variation, *Thermal stratification, *Model studies, Lakes, Phosphorus, Dissolved oxygen, Mathematical models, Simulation, Weather.

After the reduction in the contribution of sullage to Lake Nantua, the concentrations of phosphorus to the lake was greatly reduced, but the hypolimnion remains anoxic from July to November, the primary production is elevated (>100 g C/sq m/yr) and the phytoplankton population is still dominated by the cyanophyte Oscillatoria rubescens. In order to analyze the factors which are involved in the function of the lake, a mathematical model was developed for the seasonal cycle of phosphorus and oxygen. The fundamental components of the model are a group of equations which permit the

simulation of the seasonal thermal development of the lake and the variation in intensity of the process of vertical transport in response the meterological fluctuations. The model was calibrated based on data for 1972, and produced satisfactory results when used for 1973. This constitutes a validation of the model. (Moore-IVI)
W85-02611

SHORT MEROMICTIC EPISODE IN THE DEAD SEA: 1979-1982,
Weizmann Inst. of Science, Rehovoth (Israel).
M. Stiller, J. R. Gat, N. Bauman, and S. Shasha.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 1, p 132-135, July, 1984. 1 Fig, 7 Ref.

Descriptors: *Meromictic lakes, *Monimolimnion, *Dead Sea, *Salinity, *Temperature, Density, Seasonal variation, Saline lakes, Suspended solids, Halite.

The Dead Sea is a 325 m deep terminal, hypersaline lake in the Jordan Rift Valley. It is a classical example of a meromictic lake. The water column was periodically sampled at the central, deepest part of the lake. Prior to 1979, the monimolimnion was probably isolated for more than 250 yr. Its salinity was practically constant and anoxic conditions had prevailed. Due to the reduced Jordan River discharge to the Dead Sea, an overturn of the water column took place in February, 1979. During the turnover, oxygen had invaded the entire water column down to the lake bottom. By the end of 1979 salinity and temperature in the deep waters were higher by 0.6 g/kg and 1.2 C respectively than in February of that year. The onset of meromictic stratification in the winter of 1979/80 resulted in renewed isolation of the deep waters. From December 1979 to November 1982 the monimolimnion was vertically homogeneous and its potential temperature and salinity remained practically unchanged. Immediately after the turnover there was a large increase in the concentration of suspended matter throughout the water column, from 1.5 to 4.5 mg/liter. At turnover in December 1982, the surface brines had a high salinity and a relatively low temperature and thus suitable conditions for authigenic formation of halite had been reached. Halite flocs were observed floating on the lake surface on calm days and halite crystals were collected in sediment traps at 70 m depth, 23 and 178 g/sq m/day in December 1982 and January 1983, respectively. (Baker-IVI)
W85-02612

SOME CONSIDERATIONS ON ADEQUATE CONSTRUCTION OF BOX MODEL AND ITS APPLICATION,
National Inst. for Environmental Studies, Tsukuba (Japan).
For primary bibliographic entry see Field 5B.
W85-02613

CHARACTERIZATION OF PARTICULATE AND COLLOIDAL PHOSPHORUS FORMS IN WATER BY CONTINUOUS FLOW DENSITY GRADIENT CENTRIFUGATION,
Uppsala Univ. (Sweden). Limnologiska Institutionen.
G. Persson.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 1, p 149-154, July, 1984. 2 Fig, 2 Tab, 11 Ref.

Descriptors: *Cycling nutrients, *Phosphorus, *Lake Ramsjon, *Lake Siggeforasjon, *River Lidan, Particulate matter, Colloids, Continuous flow, Density currents, Algae.

The separation and characterization of particulate and colloidal phosphorus achieved by continuous flow density gradient centrifugation of lake and river waters in silica gel gradients were demonstrated for a hypereutrophic lake (Lake Ramsjon), an oligotrophic lake (Lake Siggeforasjon) and a lowland river (River Lidan). The search for suitable density gradient media and technical approaches for separation of particulate phosphorus forms in natural waters is also presented. Microscopic examination showed blue-green and chrysophycean algae to be dominant in L. Ramsjon and L. Siggeforasjon, respectively. For the river, only a minute amount of material could be observed. The algae had densities < 1.13, whereas the organic material of the heavier fractions was undefined and termed detrital/colloidal. The phosphorus content of the fractions was 0.002-0.60% of dry weight. No signficant correlation between organic content and phosphorus content of the fractions could be found. Algal phosphorus may significantly contribute to the phosphorus content of fractions of high organic content only if they contain much more phosphorus than the detritus/colloids. The centrifugal approach presented did offer a direct accumulation and separation of particulate and colloidal material solely by buoyant density. This type of separation did not successfully distinguish between functional particulate phosphorus components like algae and organic colloids in the lakes. (Baker-IVI)
W85-02614

PHOSPHORUS RESIDENCE TIME IN RELATION TO TROPHIC CONDITIONS IN LAKES,
Canada Centre for Inland Waters, Burlington (Ontario).
L. L. Janus, and R. A. Vollenweider.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 1, p 179-184, July, 1984. 2 Fig, 3 Tab, 3 Ref.

Descriptors: *Phosphorus, *Lake sediments, *Cycling nutrients, *Trophic level, Eutrophication, Lakes, Residence time, Oligotrophic lakes, Lake management.

The dependency of phosphorus residence time on such variables as lake concentration, inflow concentration, water residence time, mean lake depth and chlorophyll content was examined. The approach used for this analysis was a statistical dissection of cross-sectional relationships. Consideration was given to differences of these relationships between trophic categories. The relative residence time of phosphorus was found to be clearly related to the trophic conditions a lake. The processes which regulate the relative residence time and their magnitudes of influence differ with trophic category. Although the relative residence time is dependent on loading in oligotrophic lakes, it becomes less dependent on loading with increasing eutrophication. The movement of phosphorus through a lake and the trophic condition observed appears to be highly dependent on sediment uptake capacity for phosphorus in lakes of different trophic characteristics. Conversely, sediment properties will strongly influence the trophic response to a given load. For practical lake management, the implication following from this is that the resilience of lakes will depend on their previous history. Basically, oligotrophic lakes will respond slowly to increasing load, but rapidly to decreasing load as long as the perturbation is short in time; lakes with a long previous eutrophication history have lost resilience, and therefore will respond much more slowly to comparable load reductions. (Baker-IVI)
W85-02616

EFFECTS OF TURBULENCE ON PHOSPHORUS SUPPLY IN A SHALLOW BAY OF LAKE MEMPHREMAGOG,
McGill Univ., Montreal (Quebec). Dept. of Biology.
R. H. Peters, and A. Cattaneo.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 1, p 185-189, July, 1984. 1 Fig, 1 Tab, 21 Ref.

Descriptors: *Turbulence, *Wind, *Phosphates, *Lake Memphremagog, *Quebec, *Vermont, Bays, Phosphorus, Cycling nutrients, Seasonal variation, Lake sediments, Waves.

The effects of wind generated turbulence on orthophosphate uptake and on the concentrations of total and soluble phosphorus were examined in one bay of Lake Memphremagog (Quebec, Vermont). Although the study period included only one time of very heavy waves, surface chop was sufficient to double or treble total P concentration at the inshore station on three occasions. A smaller increase was also noted on two other occasions. These increases were very localized phenomena. The increases were also ephemeral and, when sampling was sufficient, declined to normal values within 2 days. Mean values of total P concentration on wavy and calm days also show the effects of water turbulence at inshore stations. These variations in total P had no effect on soluble P concentration. Neither the examination of mean values nor sign tests showed any trend among the three stations samples on either windy or calm days. The rate constants at all sites showed considerable fluctuation from sampling to sampling superimposed on a significant seasonal increase. Since turbulence had little effect on soluble P or on phosphate turnover at any site or time in this study, it seems unlikely that sediment resuspension serves as a mechanism of internal P loading. Possible effects of larger waves cannot be ruled out from this study. (Baker-IVI)
W85-02617

IMPORTANCE OF INTERNAL PHOSPHORUS LOAD TO THE EUTROPHICATION OF LAKES WITH ANOXIC HYPOLIMNIA,
McGill Univ., Montreal (Quebec). Dept. of Biology.
For primary bibliographic entry see Field 5C.
W85-02618

PHOSPHORUS RELEASE PATTERNS FROM SEDIMENTS OF A MEROMICTIC MESOTROPHIC LAKE (PIBURGER SEE, AUSTRIA),
Innsbruck Univ. (Austria). Dept. of Limnology.
For primary bibliographic entry see Field 5C.
W85-02619

PHOSPHORUS BUDGETS OF INDOOR RESERVOIR MODELS VARYING IN SEDIMENT COMPOSITION AND WATER INLET SITE,
Ehime Univ., Matsuyama (Japan). Dept. of Environment Conservation.
H. Kagawa, and Z. Kawabata.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 1, p 229-232, July, 1984. 4 Fig, 3 Ref.

Descriptors: *Water quality control, *Reservoirs, *Eutrophication, *Phosphorus, Model studies, Nutrients, Lake sediments, Inlet depth.

The combined effects of water inlet depth and sediment composition on the phosphorus budget were studied in order to find a way to retard the eutrophication of reservoirs. Indoor reservoir models were constructed using polyethylene tanks. The water temperature was almost the same at any depth of the two deep inflow tanks and changed seasonally along with the room temperature. In shallow inflow tanks, athough the water temperature was equal to that of the deep inflow tanks, lower temperature prevailed beneath the thermocline during cooling periods. Under these conditions total phosphorus budgets differed from tank to tank. The TP budgets of the tanks during the initial 40 days, before the emergence of filamentous algae and during the entire 496 days of operation are pictured. The cumulative amounts of TP outflow differed from tank to tank, although those of TP inflow were intentionally similar in all tanks and increased steadily during its 16 months of operation. (Baker-IVI)
W85-02620

TRANSFERS BETWEEN FORMS OF SEDIMENTARY PHOSPHORUS INDUCED BY NITRATE TREATMENT,
Uppsala Univ. (Sweden). Limnologiska Institutionen.
K. Pettersson.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 1, p 233-238, July, 1984. 1 Fig, 3 Tab, 14 Ref.

Descriptors: *Phosphorus, *Lake sediments, *Nitrates, *Lake Finjasjon, *Lake Vallentunasjon, *Sweden, *Lake Balaton, *Hungary, Bottom sediments, Mineralization.

In lake metabolism the role of the sediments is of major importance since the very significant phosphorus pool there can, if partly released to the lake water, delay lake recovery after a drastic reduction of the external nutrient loading. Sediments from accumulating bottom areas in Lake Finjasfon, Lake Vallentunasjon (Sweden) and Lake Balaton (Hungary) were treated with nitrate to evaluate the significance of mineralization for the transfers between forms of sedimentary P. Fractional composition of sedimentary P was determined before and after incubation with nitrate at 10 and 20 C. NaOH-extracted organic P decreased 47%, 33% and 43% corresponding to 16.2%, 12.8%, and 5.6% of the total P content in the sediments of Lake Finjasjon, Lake Vallentunasjon and Lake Balaton, respectively, after incubation at 20 C for 16 days. The liberated P was to a large part incorporated in bacterial biomass (41% to 66%). Concerning the Lake Finjasjon sediment about 50% of the decrease in NaOH-extracted organic P was transferred to iron- and aluminum-bound P. In Lake Vallentunasjon sediment both loosely bound P and calcium-bound P increased with about 2% of total P at 20 C. Loosely sorbed P increased with 2% of total P also in the sediment of Lake Balaton. (Baker-IVI)
W85-02621

CALCULATION OF PHOSPHORUS AND NITROGEN LOADINGS TO NATURAL AND ARTIFICIAL LAKES,
Iowa State Univ., Ames. Dept. of Animal Ecology.
R. W. Bachmann.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 1, p 239-243, July, 1984. 2 Fig, 5 Ref.

Descriptors: *Lakes, *Nutrients, *Phosphorus, *Nitrogen, Model studies, Limnology, Depth, Hydraulic flushing rate.

Several techniques have been used to estimate nutrient loadings to lakes. The possibility of using the lake itself as an integrator of P and N inputs has been examined. P and N loadings to lakes are estimated by rearranging the Vollenweider equation to predict loadings from lake measurements of total P and total N, mean depth, and hydraulic flushing rate. Whether this was a useful technique and what errors are associated with the predicted values are determined. The data for P in lakes was taken from the published literature and includes measurements on lakes from the United States, Canada and northern Europe. The technique appeared to do a good job in making order of magnitude estimates of nutrient loading. This makes the method of practical use in many situations such as seasonal surveys of many lakes over a broad geographic area, since actual loading rates can vary by several orders of magnitude from lake to lake. The method is not suitable for determining differences between very similar lakes or for detecting relatively small changes over time in a single lake. (Baker-IVI)
W85-02622

NITROGEN LOADING: INFLUENCE ON DISSOLVED INORGANIC CARBON IN NATURAL WATERS,
Hidrobioloski Zavod, Ochrida (Yugoslavia).
For primary bibliographic entry see Field 5C.
W85-02623

MODELING CHEMICAL WATER QUALITY IN RESERVOIRS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 5C.
W85-02624

SUMMARY OF US OECD EUTROPHICATION STUDY. RESULTS AND THEIR APPLICATION TO WATER QUALITY MANAGEMENT,
Texas Tech Univ., Lubbock. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5C.
W85-02625

AERATION OF ANOXIC HYPOLIMNETIC WATER: EFFECTS ON NITROGEN AND PHOSPHORUS CONCENTRATIONS,
Saskatchewan Univ., Saskatoon. Dept. of Soil Science.
For primary bibliographic entry see Field 5G.
W85-02626

SEASONAL CHANGES IN TOTAL PHOSPHORUS AND THE ROLE OF INTERNAL LOADING IN WESTERN CANADIAN LAKES,
Alberta Univ., Edmonton. Dept. of Zoology.
E. E. Prepas, and J. Vickery.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 1, p 303-308, July, 1984. 1 Fig, 1 Tab, 15 Ref.

Descriptors: *Phosphorus, *Seasonal variation, *Lake sediments, *Alberta, *Internal loading, Vertical distribution, Mixing, Nutrients.

During 1980 and 1981 data on seasonal variations in the vertical distribution of total phosphorus (TP) were collected on 15 lakes in central Alberta. These data are used to evaluate whether internal sources of TP were responsible for the temporal variation observed in these lakes. The study lakes are located in the boreal mixed-wood and lower transition biomes in central Alberta. Based on various patterns of the data the lakes were divided into shallow and deep lakes. Internal loading was indeed responsible for the temporal changes observed in the TP levels in these lakes. The sediments appear to be a major P source. TP concentrations increased in the hypolimnion when dissolved oxygen levels were low, beginning at the sediment-water interface. Surface water TP levels increased when phosphorus-rich water from the hypolimnion was mixed with relatively dilute water from the epilimnion. In deep lakes, TP levels increased systematically in the hypolimnion, when the euphotic zone did not extend in the phosphorus-rich hypolimnetic water. Although TP levels have increased in the hypolimnia of other lakes when the dissolved oxygen levels were low, these increases have not been very systematic. In this study a systematic increase was detectable. In the shallow lakes, TP levels fluctuated dramatically throughout the water column during the study period. To determine the contribution of sediment-released P to the TP dynamics in shallow lakes samples would have to be collected daily rather than weekly as was the case in this study. (Baker-IVI)
W85-02630

EMPIRICAL MODELS FOR PREDICTION OF ALGAL BLOOMS AND COLLAPSES, WINTER OXYGEN DEPLETION AND A FREEZE-OUT EFFECT IN LAKES: SUMMARY AND VERIFICATION,
Canada Centre for Inland Waters, Burlington (Ontario).
J. Barica.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 1, p 309-319, July, 1984. 9 Fig, 3 Tab, 22 Ref.

Descriptors: *Lakes, *Eutrophication, *Algae, *Model studies, Seasonal variation, Fishkills, Winterkill, Summerkill, Dissolved oxygen, Prairies, Ice cover, Freeze-out.

Three empirical predictive models, developed for eutrophic shallow prairie lakes during 1973-1979, were summarized and tested on other lakes to assess their validity. A summerkill risk prediction model, based on maximum mid-winter ammonia-nitrogen and maximum summer chlorophyll a relationship, was used to estimate the likelihood of an algal bloom collapse and consequent fish kill from oxygen depletion in 42 new lakes, with prediction accuracy of 88%. A winterkill prediction nomogram, relating oxygen depletion rates, mean depth of the lake, and length of ice cover, was found to be valid also for large lakes and hypolimnetic oxygen depletion in shallow stratified lakes. A freeze-out model describing behavior of inorganic substances in shallow lakes under ice cover was confirmed for winter increases of hardness and gas saturation. The extra data sets used in testing, proved general validity of all three models and their applicability to fisheries and water quality management even though their true causal character was not sufficiently analyzed. (Baker-IVI)
W85-02631

SEDIMENT GEOCHEMISTRY IN A EUTROPHIC LAKE COLONIZED BY THE SUBMERSED MACROPHYTE MYRIOPHYLLUM SPICATUM,
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
R. Carignan.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 1, p 355-370, July, 1984. 8 Fig, 6 Tab, 10 Ref.

Descriptors: *Buckhorn Lake, *Ontario, *Eutrophic lakes, *Macrophytes, *Lake sediments, *Geochemistry, Iron, Chemical reactions, Population density, Interstitial water, Myriophyllum, Hydrogen sulfide.

Buckhorn Lake is a shallow heavily cottaged eutrophic lake of Southeastern Ontario which offers a good example of the extremely variable nature of macrophyte communities. An attempt was made to characterize the sediment geochemistry of several sites sustaining variable biomasses in order to identify possible macrophyte-sediment interactions that could explain the dynamic and variable nature of the macrophyte communities of this lake. Sediments sustaining a high macrophyte density were characterized by elevated total phosphorus and pore water nutrient concentration relative to deeper pelagic sediments. This suggests that at high densities, macrophytes cause an increase in organic matter and nutrient loading to the sediments. Sediments sustaining low or declining biomasses were characterized by the authogenic formation of a carbonate apatite, very low pore water iron and phosphate, low redox potential, and relatively high levels of hydrogen sulfide and ammonia. In lab experiments, the growth of Myriophyllum was slightly stimulated by iron additions to the sediments. The natural level of hydrogen sulfide observed in these sediments did not inhibit growth. In the lake, the presence of high densities of macrophytes appears to trigger a series of sedimentary geochemical reactions unfavorable to plant growth and explaining the site-specific decline of Myriophyllum. (Baker-IVI)
W85-02633

EFFECTS OF PHOSPHORUS FERTILIZATION ON PHYTOPLANKTON BIOMASS AND PHOSPHORUS RETENTION IN SUBARCTIC QUEBEC LAKES,
McGill Univ., Montreal (Quebec). Dept. of Biology.
V. H. Smith, F. H. Rigler, O. Choulik, M. Diamond, and S. Griesbach.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 1, p 376-382, July, 1984. 3 Fig, 2 Tab, 22 Ref.

Descriptors: *Lakes, *Phosphorus, *Phytoplankton, *Quebec, *Subarctic zone, Nutrients, Eutrophication, Algal growth, Biomass, Model studies.

A long term study of lakes from 1977-1983 in the Canadian subarctic near Schefferville, Quebec suggests that existing empirical water quality models can be used successfully in the North. The growth response of phytoplankton to nutrients appears similar in both subarctic and temperate zone lakes. Ice-free season chlorophyll concentrations are predicted reasonably well by the Dillon and Rigler model (Limnol. Oceanogr. 19:767-773, 1974), but can be predicted with even greater precision by the multivariate model of Smith (Limnol. Oceanogr. 27:1101-1112, 1982). The Schefferville results thus underscore the importance of nitrogen as a regulator of phytoplankton productivity in lakes. Preliminary results also suggest that phosphorus retention in subarctic lakes can best be predicted with the Ostrofsky model (J. Fish. Res. Bd. Can. 35:1532-1536, 1978), and suggest further that P retention may be higher in subarctic than in temperate zone lakes. This hypothesis should be tested

further using data from subarctic lakes from other regions of the world. (Baker-IVI)
W85-02635

EFFECTS OF AN IN SITU ARTIFICIAL ACIDIFICATION ON THE LACUSTRINE PHYTOPLANKTON AND ZOOPLANKTON (EFFETS D'UNE ACIDIFICATION ARTIFICIELLE IN SITU SUR LE PHYTOPLANCTON ET LE ZOOPLANCTON LACUSTRE),
Ecole Polytechnique, Montreal (Quebec). Section du Genie de l'Environnement.
For primary bibliographic entry see Field 5C.
W85-02636

PLANKTON OF AN ACID-STRESSED LAKE (KEJIMKUJIK NATIONAL PARK, NOVA SCOTIA, CANADA); PART 1, DESIGN AND WATER CHEMISTRY RESULTS OF AN ENCLOSURE EXPERIMENT,
Dalhousie Univ., Halifax (Nova Scotia). Dept. of Biology.
T. M. Colins, and P. A. Lane.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 1, p 395-400, July, 1984. 4 Fig, 1 Tab, 7 Ref. Environment Canada grant OSC82-00113.

Descriptors: *Plankton, *Acidification, *Kejimkujik National Park, *Nova Scotia, *Beaverskin Lake, Food chains, Lime, Nutrients, Nitrogen, Phosphorus, Chlorophyll, Water pollution effects.

The stress of acid deposition affects more than a species list or set of distribution patterns for plankton populations; whole food webs may be inextricably altered. The food web of the pelagic zone of a lake was examined using a multiple enclosure system. Plankton communities were monitored for their responses to acidification, liming, and nutrient loading in Beaverskin Lake, pH 5.5. The pH was manipulated and subsequent physical and chemical effects were examined. Similar nutrient trends were observed in the controls, limed and acidified enclosures. The nutrient enriched enclosures clearly showed increases in N, P, and chlorophyll a values. Some type of auxiliary buffering was acting at lower pH and this could be a result of either a physical or biological enclosure effect. A trend of uniformity at the nutrient level does not necessarily imply that the other trophic levels indirectly related to the perturbation will be as consistent. (Baker-IVI)
W85-02637

GROWTH RESPONSES OF RIVER AND LAKE PHYTOPLANKTON POPULATIONS IN LAKE MICHIGAN WATER,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
C. L. Schelske, C. O. Davis, and L. E. Feldt.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 1, p 445-451, July, 1984. 4 Fig, 2 Tab, 10 Ref.

Descriptors: *Lakes, *Phytoplankton, *Lake Michigan, *Grand River, Nutrients, Chlorophyll, Algal growth, Eutrophication, Diatoms, Standing crop.

The effects of P and river water on deep-living phytoplankton populations and the fate of seeded river populations in lake water were examined. Filtered and unfiltered river water and P were added to samples of lake water taken at the depth of the subsurface chlorophyll maximum at a station removed from the influence of tributaries. Additions of river water were 0, 1, 2, 5, and 10% and of phosphorus were 0, 1, 2, 5, and 10 micro g P/liter. Chemical conditions and phytoplankton in the Grand River and the offshore lake were very different. Conditions at the lake stations varied vertically with a phytoplankton maximum at 32 m. This subsurface assemblage was dominated by diatoms whereas the mixed layer assemblage contained smaller proportions and much smaller populations of diatoms. Greatest community responses, as measured by increases in chlorophyll a were obtained in the unfiltered river water treatments with doublings in concentrations for the 2, 5, and 10% treatments. Standing crops increased with treatment because of the phytoplankton added with unfiltered water. Greater increases in chlorophyll a were obtained with P treatments than with filtered river water treatments. Nutrient utilization rates were greatest in unfiltered river water treatments and least with filtered river water. The results show that some allochthonous river populations can grow under the light and temperature conditions that might be found at the depth of the subsurface chlorophyll maximum. (Baker-IVI)
W85-02638

LONG-TERM PHYTOPLANKTON CHANGES IN LAKE MICHIGAN: CULTURAL EUTROPHICATION OR BIOTIC SHIFTS,
Wisconsin Univ.-Milwaukee. Center for Great Lakes Studies.
A. S. Brooks, G. J. Warren, M. E. Boraas, D. B. Scale, and D. N. Edgington.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 1, p 452-459, July, 1984. 1 Fig, 1 Tab, 43 Ref. EPA grant R005655-01.

Descriptors: *Phytoplankton, *Sodium, *Lake Michigan, *Great Lakes, *Eutrophication, Lakes, Cyanophyta, Zooplankton, Phosphorus, Water pollution effects.

The effects of elevated sodium ion concentration, alone and combined with elevated phosphoconcentration were studied on the community dynamics of Lake Michigan phytoplankton using laboratory continuous culture techniques which simulate field conditions as closely as possible. The hypothesis that elevated sodium concentration would promote the competitive abilities of one or more cyanophyte species such that the phytoplankton community would become dominated by cyanophytes was investigated. Experimental evidence suggests that the abundance of large filamentous cyanophytes depends on the abundance of large zooplankton. It appears that whereas changing chemical conditions in Lake Michigan may exert some influence on phytoplankton abundance and community structure, overriding biotic factors must also be considered before drawing conclusions which may significantly influence regulatory strategies and management policies. (Baker-IVI)
W85-02639

PHYTOPLANKTON STANDING STOCK, SIZE DISTRIBUTION, SPECIES COMPOSITION AND PRODUCTIVITY ALONG A TROPHIC GRADIENT IN GREEN BAY, LAKE MICHIGAN,
Lawrence Univ., Appleton, WI. Dept. of Biology.
S. Richman, P. E. Sager, G. Banta, T. R. Harvey, and B. T. Destasio.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 1, p 460-469, July, 1984. 9 Fig, 2 Tab, 24 Ref. Sea Grant NA80OAA-D-00086.

Descriptors: *Phytoplankton, *Green Bay, *Lake Michigan, Trophic level, Great Lakes, Primary productivity, Nutrients, Sinks, Standing stock, Distribution.

During the summer of 1982 the phytoplankton community was examined along the longitudinal axis of Green Bay at 12 stations which were then combined into five regions from south to north. The trophic gradient is easily discernible from the data tables. The response of the phytoplankton community to these gradients was determined in terms of shifts in species composition, particle size distribution of standing stock and productivity. The most obvious trend in the microscope enumeration is the decrease in phytoplankton concentrations from south to north in the bay. A second trend, but a more subtle one, is seen in the concentration increase which came about slowly over the summer. All the data indicate that the phytoplankton assemblage was shifting from smaller to larger forms during this time. These qualitative changes in the phytoplankton composition provide further support of the trophic gradient in Green Bay. The values obtained for phytoplankton density, phytoplankton biovolume, chlorophyll a and primary productivity are closely related to each other as shown by highly significant correlation coefficients. These findings emphasize the importance of the bay as a nutrient sink, especially in reducing the enrichment effects of the Fox River for Lake Michigan. (Baker-IV)
W85-02640

BENTHIC AND EPIBENTHIC (MICROCRUSTACEANS, MACROBENTHOS) COMMUNITY STRUCTURE IN THE VICINITY OF A POWER PLANT, SOUTHEASTERN LAKE MICHIGAN,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
For primary bibliographic entry see Field 5C.
W85-02641

BIOLOGY, ECOLOGY AND CHEMISTRY OF A FLOC-LIKE SEDIMENT IN LAKE ERIE,
State Univ. of New York at Buffalo. Dept. of Biological Sciences.
J. F. Storr, J. R. Fox, P. J. Hadden-Carter, and C. J. Cazeau.
Verhandlung Internationale Verinigung Limnologie, Vol. 22, No. 1, p 504-509, July, 1984. 4 Fig, 11 Ref.

Descriptors: *Lake sediments, *Lake Erie, *Plankton, *Floc, Great Lakes, Sediments, Algae, Chemical composition, Aquatic animals, Organic matter, Cholesterol, Tubifex.

A floc-like veneer of organic-rich material was found as a loose quasi-floating layer up to 25 cm thick overlying sediments in the deeper (6 to 10 m), quiet portions of eastern Lake Erie. Steps were taken to determine the rate of plankton rainout, the amount of build-up on the bottom, the distribution of the floc, and the chemical composition of the floc in comparison to unconsolidated sediments. Fifteen bottom sampling stations were established along a 17 km transect from Point Abino on the Canadian side to Sturgeon Point on the American side of Lake Erie. The maximum rate of plankton rainout occurred in one two-week period in July. Highest rates occurred near the shore. Floc was generally found below the 10 m depth, up to 18-25 cm thick at depths over 16.5 cm. Where accumulation occurred, oxygen values fell from about 5 ppm in upper waters to less than 3 ppm in the bottom 2 to 3 m. Algae were found only at near-shore stations. Tubifex worms were predominant at stations where floc was thickest. Cholesterol was identified as the major component of the unsaponifiable fraction of sediment. Twelve peaks, representing specific compounds, were held in common by plankton, floc and sediment samples. Percent dry weight of ether and water soluble extracts peaked dramatically just under the sediment surface. The amount of ethanol extractable resins was greatest at the surface, declining gradually to a particular sampling site where it fell off dramatically. (Baker-IVI)
W85-02642

MT. ST. HELENS ASH IN LAKES IN THE LOWER GRAND COULEE, WASHINGTON STATE,
Washington Univ., Seattle. Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W85-02643

CRATER LAKE STUDY: DETECTION OF POSSIBLE OPTICAL DETERIORATION OF A RARE, UNUSUALLY DEEP CALDERA LAKE IN OREGON, U.S.A.,
Army Engineer District, Portland, OR.
D. W. Larson.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 1, p 513-517, July, 1984. 2 Tab, 25 Ref.

Descriptors: *Crater Lake, *Oregon, *Optical properties, Opacity, Plankton, Limnology, Transparency, Nutrients, Diatoms, Caldera lakes.

The uniqueness and vulnerability of the Crater Lake environment was examined and the limnological data, gathered since 1967, was summarized. Crater Lake is located along the summit of the Oregon Cascade Range, about 105 km north of the

Oregon-California border, and about 195 km inland from the Pacific Ocean. Secchi disk readings for 1937 and 1969 averaged 38.3 and 36.6 m, respectively while the average value for 1978 was 29.3 m. The cause of this trend toward decreased transparency is uncertain. There may have been an increase in suspended particulate matter. Some evidence suggests that the lake has become more productive biologically perhaps as a result of increased algal nutrients present in the water. The phytoplankton community consists of more than 150 species, although fewer than 10 of these are dominant. Roughly 90% are diatoms, 15 of which belong to the genus Nitzschia. The vertical distribution of phytoplankton is characterized by three maxima: at the surface, 0-20 m; at middepth, 80-120 m; and near the bottom of the profile, 180-200 m. The regular presence of large numbers of diatoms at the 0-20 m stratum is in sharp contrast with findings reported by earlier investigators. (Baker-IVI)
W85-02644

NUTRIENT REDUCTION BY BIOMANIPULATION: AN UNEXPECTED PHENOMENON AND ITS POSSIBLE CAUSE,
Minnesota Univ., Minneapolis. Limnological Research Center.
For primary bibliographic entry see Field 5G.
W85-02645

LAKE ACIDIFICATION AND THE BIOLOGY OF ADIRONDACK LAKES: I. ROTIFER COMMUNITIES,
New York State Museum, Albany. Science Service Div.
For primary bibliographic entry see Field 5C.
W85-02646

RECENT PH HISTORY OF BIG MOOSE LAKE (ADIRONDACK MOUNTAINS, NEW YORK, U.S.A.) INFERRED FROM SEDIMENT DIATOM ASSEMBLAGES,
Indiana Univ. at Bloomington. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W85-02647

FORMS AND DISTRIBUTION OF CARBON IN SEDIMENTS OF CASTLE LAKE, CALIFORNIA, U.S.A.,
Michigan State Univ., Hickory Corners. W.K. Kellogg Biological Station.
R. G. Carlton.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 1, p 578-582, July, 1984.

Descriptors: *Lake sediments, *Carbon, *Castle Lake, *California, Oligotrophic lakes, Organic matter, Nutrients, Productivity, Particulates, Light availability.

The function of sediment in the nutrient dynamics of oligotrophic Castle Lake, California was investigated. The data which characterized the carbon constituents of Castle Lake are presented and the significance of organic content in sediments is discussed with emphasis on the factors which control the quality and quantity of carbon in sediments. Several factors directly affect the quantity and quality of organic matter in these sediments. A primary consideration is the source of particulate materials. Allochthonous sources have not been quantified. Autochthonous sources include particle production in the water column and in situ production by the sediment microbial community. The high organic content of surficial sediments of the littoral stations was probably a result of high production rates by algae and microheterotrophs. Productivity rates at deeper sites are unknown, but areas with lower light and temperature should have lower algal production. Therefore, sedimented seston becomes more important at depths with lower epipelic production. The fundamental characteristic which distinguishes sediment of Castle Lake from that of most other lakes is the high concentration of organic matter, particularly in sediment of the littoral zone. Relationships between sediment particulate organic matter and lake trophic state must be interpreted with regard to the availability of light at the sediment water interface and the degree of oxygen saturation and depth of the water column. (Baker-IVI)
W85-02648

HETEROTROPHIC BACTERIAL COMMUNITY IN OLIGOTROPHIC LAKE TAHOE,
Tokyo Metropolitan Univ. (Japan). Dept. of Biology.
Y. Watanabe, and C. R. Goldman.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 1, p 584-590, July, 1984. 4 Fig, 1 Tab, 16 Ref. Japan Ministry of Education Grant C-5754032, NSF grant BSR80-19918, California State Water Resources Control Bd. grant 1-009-160-0.

Descriptors: *Oligotrophic lakes, *Bacteria, *Lake Tahoe, Eutrophication, Nutrients, Phosphorus, Nitrogen, Carbon, Water pollution effects, Solar radiation, Ecological distribution.

Horizontal and vertical distribution of heterotrophic bacteria in highly oligotrophic Lake Tahoe are clarified. Here the eutrophication process brought about by human activity proceeds slowly but relentlessly. Very low densities of planktonic bacteria were recorded in viable counts of samples taken from the epilimnion of the lake center and at a station off the west shore. In contrast, much higher counts were found in areas subject to human impact such as a yacht harbor and shallow channels in a residential zone at the south shore. Total counts of bacterial samples were rather high. The ratio of the viable to total counts was higher in the more eutrophic water. Periphytic bacterial density on the lake bottom rocks in the littoral zone was rather high and stable almost irrespective of the depth and the abundance of periphtyic organic matter. Many bacterial cells were attached to the epilithic algae and detrital particles on the rocks. There was a tendency for most of the bacteria in unpolluted lake water to be chromogenic, forming yellow to deep red-colored colonies on the culture plate. Those in the sample from the polluted area were not chromogenic. No correlation was noted between the bacterial density and the water temperature or primary productivity. Decrease of bacterial density was found in both viable and total counts in the upper photic zone above the Secchi depth of the water column. The negative effect of sunlight on bacterial growth was demonstrated. Both planktonic and periphytic bacteria in Tahoe are limited by a shortage of N and P as well as by organic C. (Baker-IVI)
W85-02649

PRIMARY PRODUCTIVITY AND PRECIPITATION AT CASTLE LAKE AND LAKE TAHOE DURING TWENTY-FOUR YEARS, 1959-1982,
California Univ., Davis. Div. of Environmental Studies.
C. R. Goldman, and E. de Amazaga.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 1, p 591-599, July, 1984. 5 Fig, 30 Ref. NSF grant DEB-8019918.

Descriptors: *Primary productivity, *Precipitation, *Lake Tahoe, *Castle Lake, *California, Nutrients, Seasonal variation, Flushing, Nutrients, Algae.

Castle Lake is a subalpine lake located in northern California at an altitude of 1706 m where it lies in a protected cirque basin. The lake is covered with ice and snow for 5 to 6 months of the year and receives almost no rain during the summer. Lake Tahoe does not freeze in winter and about a third of the water column receives sufficient light for photosynthesis. Primary productivity in Castle Lake over the period of 24 years averaged 64 g C/sq m/yr. From June through September, 69% of the primary productivity occurred. The highest carbon fixation took place during July and August. The lake shows an alternative pattern of high and low years of primary productivity. In Castle Lake, annual primary productivity shows no significant trend with time. Primary productivity in Lake Tahoe has increased from 39 g C/sq m/yr in 1959 to a high of 96 g C/sq m/yr in 1980. Lakes such as Castle Lake which are subject to accelerated flushing during years of heavy rain and snowpack have both nutrients and algae flushed out by heavy flow-through. In Lake Tahoe the relationship of precipitation and primary productivity (PPr) was examined but no direct relation was found between water year precipitation and PPr. By using the percentage change in primary productivity between successive years in comparison to precipitation during the corresponding water years, an excellent positive regression results if two anomalous years are excluded. (Baker-IVI)
W85-02650

LITTORAL PHYTOPLANKTON PRODUCTIVITY AND BIOMASS AS INDICATORS OF DIFFERENTIAL NUTRIENT LOADING OF LAKE TAHOE,
California Univ., Davis. Inst. of Ecology.
For primary bibliographic entry see Field 5C.
W85-02651

VARIABILITY IN PHOSPHORUS CONCENTRATIONS IN NORTH TEMPERATE LAKES: A CASE STUDY OF ANTHROPOGENIC FORCING,
Salford Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5C.
W85-02652

EFFECTS OF ROTENONE TREATMENT ON THE BENTHIC FAUNA OF A SMALL EUTROPHIC LAKE,
Trondheim Univ. (Norway).
For primary bibliographic entry see Field 5C.
W85-02653

RESULTS OF SEEPAGE METER AND MINI-PIEZOMETER STUDY, LAKE MEAD, NEVADA,
Montana Univ., Missoula. Dept. of Geology.
W. W. Woessner, and K. E. Sullivan.
Ground Water, Vol. 22, No. 5, p 561-568, September-October, 1984. 9 Fig, 18 Ref.

Descriptors: *Seepage meters, *Piezometers, *Surface-groundwater interactions, *Lake Mead, *Nevada, Groundwater recharge, Reservoirs, Groundwater discharge, Bank recharge, Calcium sulfate.

The seepage meter and the mini-piezometer were utilized in an attempt to evaluate ground-water reservoir interactions over a 12-month period at Echo Bay in Lake Mead. In conjuction with these techniques three standard piezometers, refraction seismic data, and water chemistry data were utilized to interpret seepage device results. During a four-month period, from December 1979 to March 1980, an 8 ft (2.5 m) rise in reservoir stage, the reservoir contributed water to Echo Wash bank storage at rates of up to 0.29 gpd/sq ft (12 lpd/sq m). Ground-water discharge occurred for the remainder of the project, during a stage decline from April 1980 to May 1980, a rise in June 1980, and leveling off and slight decline for the remainder of the year, July 1980 to December 1980. The maximum seepage meter ground-water discharge rate of 3.0 gpd/sq ft (122 lpd/sq m) was recorded in December 1980. Seepage meter water chemistry data for June were similar to Lake Mead water chemistry and were interpreted to be previously recharged Lake Mead water. September water chemistry data showed two possible components of ground-water discharge, a high SpC calcium sulfate Echo Wash ground water and a lower SpC Lake Mead recharged bank storage water. December ground-water chemistry data showed discharge to be a high SpC calcium sulfate water similar to Echo Wash ground-water quality which was apparently unaffected by Lake Mead inflow. Mini-piezometer data were collected at each seepage meter site. However, these data usually did not provide correlative results with seepage meter data probably because of suspended sediment in the piezometer water column and plugging of the perforated tip. Seepage meters were successfully utilized to characterize reservoir ground-water interaction in Echo Bay. (Author's abstract)
W85-02688

2I. Water In Plants

ZONATION OF MOSSES AND LICHENS ALONG THE SALMON RIVER IN IDAHO,
Montana Univ., Missoula. Dept. of Botany.
For primary bibliographic entry see Field 2E.
W85-02330

CONCEPT OF DROUGHT ADAPTATION (LA NOTATION D'ADAPTATION A LA SECHERESSE),
Centre National de la Recherche Scientifique, Gif-sur-Yvette (France). Lab. du Phytotron.
N. Vartanian, and G. Lemee.
Bulletin de la Societe Botanique de France, Actualites Botaniques, Vol. 131, No. 1, p 7-15, 1984. 1 Fig, 33 Ref.

Descriptors: *Drought resistance, *Adaptation, Plant morphology, Plant physiology, Plant tissues, Vegetation, Water stress.

The concept of drought adaptation is discussed in terms of dynamic reaction, or strain, as a response to an environmental water stress. As a result of structural and functional modifications induced, different strategies may contribute to drought resistance. The major types of drought adaptation are: drought avoidance, which supposes that the plant is able to erect barriers between its living matter and the environment, enabling the maintenance of a steady state water potential (homoiohydry); and drought tolerance (poikilohydry) which implies maintaining its water potential equilibrium with the environment. Avoidance of the dehydration strain, a characteristic of higher plants, is attained through numerous ways which are largely morphological and anatomical in nature; dehydration tolerance, a more primitive adaptation typical of lower terrestrial organisms, depends on specific, intrinsic properties of the protoplasm. Whether total drought resistance results mostly in survival or productivity will depend on the equilibrium between adaptive strategies. (Author's abstract)
W85-02331

VARIABILITY IN ADAPTIVE MECHANISMS TO WATER DEFICITS IN ANNUAL AND PERENNIAL CROP PLANTS,
Cordoba Univ. (Spain).
E. Fereres.
Bulletin de la Societe Botanique de France, Actualites Botaniques, Vol. 131, No. 1, p 17-32, 1984. 11 Fig, 1 Tab, 64 Ref.

Descriptors: *Adaptation, *Crop plants, *Water deficits, Productivity, Water stress, Dehydration, Leaves, Water potentials.

Terrestrial plants have evolved numerous mechanisms which enable them not only to survive, but to achieve substantial productivity levels under drought. Most adaptive mechanisms appear to be directed at either avoiding or tolerating plant water deficits. The sensitivity of leaf area expansion to mild water stress is emphasized, suggesting that it has adaptive significance by acting as a partitioning mechanism which favors root growth and hence improves the shoot water status. Alterations in developmental pathways often aid the plant in avoiding dehydration by adjusting its life cycle to the available water supply. Mechanisms of dehydration tolerance include the control of transpiration and the maintenance of turgor through osmotic adjustment. Examples of adaptive mechanisms and their possible role in yield responses under water stress are presented for sorghum, cotton and sunflower as annuals and orange, almond and olive trees as perennials. There is substantial variability in the degree of expression of several adaptive mechanisms and this has important implications for the improvement of crop production under water stress. (Author's abstract)
W85-02332

SOME DATA AND REFLECTIONS ON THE DROUGHT RESISTANCE MECHANISMS OF MAIZE AND SUNFLOWERS (QUELQUES DONNEES ET REFLEXIONS SUR LES MECANISMES DE RESISTANCE A LA SECHERESSE A PARTIR DES EXEMPLES DU MAIS ET DU TOURNESOL),
Institut National de la Recherche Agronomique, Clermont-Ferrand (France). Station d'Agronomie.
J. Morizet, P. Cruiziat, and D. Togola.
Bulletin de la Societe Botanique de France, Actualites Botaniques, Vol. 131, No. 1, p 33-43, 1984. 5 Fig, 1 Tab, 15 Ref.

Descriptors: *Drought resistance, *Maize, *Sunflowers, Productivity, Hydroponics, Water uptake, Plant physiology.

In this paper, the term drought resistance is used from its agronomic sense, i.e. the ability for a crop to produce a yield under 'dry conditions' not much inferior to yield under 'wet conditions'. Aspects of the water relations and growth were compared between two drought tolerant and non tolerant varieties of maize and between sunflower and maize. Concerning the varieties of maize, our results show that during the post drought period, the increase in net assimilation of the drought tolerant varieties is much higher. Concerning maize and sunflower, comparisons were made on transpiration and photosynthesis during a short period of drought (a few hours) induced by lowering of the root temperature in hydroponic culture of the two species. The results show a great analogy with those observed under field conditions for the whole cycle of vegetation; that is, a better drought tolerance in sunflower than in maize. Great distance still exists between the theoretical work suggesting schemes of drought resistance and knowledge of the actual physiological mechanism involved. (Author's abstract)
W85-02333

AGRONOMIC ASPECTS OF DROUGHT RESISTANCE OF THE SUNFLOWER (HELIANTHUS ANNUUS L.) (ASPECTS AGRONOMIQUES DE LA RESISTANCE A LA SECHERESSE CHEZ LE TOURNESOL (HELIANTHUS ANNUUS L.)),
A. Merrien, and R. Blanchet.
Bulletin de la Societe Botanique de France, Actualites Botaniques, Vol. 131, No. 1, p 45-50, 1984. 2 Fig, 1 Tab, 11 Ref.

Descriptors: *Drought resistance, *Sunflower, *Water use efficiency, *Plant physiology, France, Plant tissues, Water stress, Dehydration, Leaves, Photosynthesis.

If high yields are to be possible for most cultivated crops, the control of water consumption, the first limiting factor under the climate of south-west France, will be more and more important. Part of this water consumption control will perhaps be obtained by breeding new varieties adapted to drought. To increase information about whole-plant behavior, and to conduct some preliminary tests particulary useful for breeders, studies on the consequences of water stress on plant physiology and production are important. An example of the resistance process is leaf area adjustment to water availability in sunflowers and the consequences on photosynthesis; another example explains why an increase in water use efficiency is noticed for sunflowers under dry conditions. Based on these examples, the sunflower presents some drought resistant characteristics. (Author's abstract)
W85-02334

APPLICATION OF FUNDAMENTAL STUDIES ON THE IMPROVEMENT OF DROUGHT RESISTANCE OF PLANTS (APPLICATIONS DES ETUDES FONDAMENTALES A L'AMELIORATION DE PLANTES RESISTANTES A LA SECHERESSE),
Paris-7 Univ. (France). Lab d'Ecologie Generale et Appliquee.
J. Vieira Da Silva.
Bulletin de la Societe Botanique de France, Actualites Botaniques, Vol. 131, No. 1, p 51-57, 1984. 6 Tab, 16 Ref.

Descriptors: *Drought resistance, *Brazil, *Cotton, *Plant physiology, Plant breeding Crop production, Dehydration, Genetics, Stomata, Phosphorus.

In semiarid conditions of Northeast Brazil, with an irregular but somewhat long rainfall period, fundamental ecophysiological research demonstrated that drought resistance in cotton depends: a) on a fast growth of root system, b) on a root system size enabling the plant to exploit a more important water reserve, c) on a large starch amount in the root providing for periods with stomata closure and d) on a great cellular resistance to dehydration which maintains the integrity of cellular internal compartmentation. Conditions b) and c) depend also on a late flowering enabling the translocation of photosynthates to roots. Indeterminate flowering and fruiting is necessary to profit from late rains. Selection criteria, for the screening of a great number of plants, were modified from fundamental research results. Those criteria are: a) speed of root growth of seedlings (experience shows that this character is linked with final size of root systems), b) amount of starch in roots, c) leaching of inorganic phosphorus after a drought or heat treatment which means disruption of chloroplast membranes and activation of acid phosphatase. These characteristics seem to be poiygenic in heredity, as it occurs in most complex physiological phenomena; the breeding system adapted was recurrent selection which conserves population variability. Selection for root growth in the seedling stage showed a gain in the root system size with heritability of 37% and a genetic gain of 65%. After one recurrent cycle for starch content in roots, the heritability was 22.4% and genetic gain 12.1%. Heritability of inorganic phosphorus leaching after an osmotic treatment of leaf fragments is of 38.1% with a genetic gain of 12.5% for the 2nd cycle and of 11.9% for the 3rd cycle. These results show that selection procedures can be adapted from previous physiological research and that a close link between the ecophysiologist and the breeder, is necessary. (Author's abstract)
W85-02335

ROLE OF THE PHOTOPERIOD ON DROUGHT ADAPTATION OF COTTON (ROLE DE LA PHOTOPERIODE DANS L'ADAPTATION A LA SECHERESSE DES COTONNIERS),
Centre National de la Recherche Scientifique, Gif-sur-Yvette (France). Lab. du Phytotron.
C. Hubac, M. Ouedraogo, D. Guerrier, and J. Ferran.
Bulletin de la Societe Botanique de France, Actualites Botaniques, Vol. 131, No. 1, p 79-88, 1984. 3 Fig, 4 Tab, 28 Ref.

Descriptors: *Cotton, *Drought resistance, *Photoperiod, Plant physiology, Plant tissues, Leaves, Stomata, Water potential, Transpiration, Water use efficiency, Photoperiodism, Potassium.

Cotton resistance to drought stress was increased with exposure to short photoperiods. This process was phytochrome dependent, as shown by the effect of red light (R) and far red light (FR). Especially 30 min. of FR at the beginning of the dark period increased strongly the resistance. This increase was measured by the evolution of water, osmotic and turgor potentials during stress; there is water economy with short photoperiod. A strategy for water economy is the degree of stomatal aperture; with far red treatment, stomatal aperture was reduced, transpiration and water adsorption by roots decreased. These effects could be linked to modifications of inner solute concentration, especially potassium ions, and to modifications of lipid composition. The hypothesis of membrane permeability modification is discussed. (Author's abstract)
W85-02336

ACTION OF DROUGHT ON POLAR LIPIDS IN THE LEAVES OF COTTON (GOSSYPIUM HIRSUTUM L.) (ACTION DE LA SECHERESSE SUR LES LIPIDES POLAIRES DES FEUILLES DE COTONNIER (GOSSYPIUM HIRSUTUM L.),
Paris-7 Univ. (France). Lab d'Ecologie Generale et Appliquee.
A. T. Pham Thi.

Bulletin de la Societe Botanique de France, Actualites Botaniques, Vol. 131, No. 1, p 89-97, 1984. 2 Fig, 5 Tab, 22 Ref.

Descriptors: *Cotton, *Drought, *Lipids, *Leaves, Galactolipids, Phospholipids, Plant physiology.

Cotton plants (Gossypium hirsutum L. cv. Reba, drought-sensitive and Moco-sinho, drought-resistant) were submitted to water stress by withholding irrigation. Polar lipid content of leaves decreased, the galactolipids being more affected than the phospholipids. The percentage of linolenic acid (18 : 3) decreased, mostly in the galactolipid fraction. The drought resistant variety showed less pronounced variations than the sensitive one. Differences between the two varieties appeared after hardening treatment which consisted of 3 cycles of slight water stress followed by rehydration. In Mocosinho, the content of monogalactosyl-diacylglycerol increased significantly, and an augmentation of phosphatidyl choline was also observed. In Reba, on the contrary, both galactolipid and phospholipid content decreased. (Author's abstract)
W85-02337

CHANGES IN THE CONTENT OF POLYAMINES AND THEIR PRECURSORS DURING THE MORPHOGENETIC ADAPTATION IN RAPE, BRASSICA NAPUS L. VAR. OLEIFERA M. A LA SECHERESSE (VARIATIONS DES TENEURS EN POLYAMINES ET LEUR PRECURSEURS AU COUR DE L'ADAPTATION MORPHOGENETIQUE DU COLZA, BRASSICA NAPUS L. VAR. OLEIFERA M. A LA SECHERESSE),
Centre National de la Recherche Scientifique, Gif-sur-Yvette (France). Lab. du Phytotron.
A. Geay, N. Vartanian, and O. Queiroz.
Bulletin de la Societe Botanique de France, Actualites Botaniques, Vol. 131, No. 1, p 99-111, 1984. 10 Fig, 1 Tab, 29 Ref.

Descriptors: *Drought, *Rape, *Polyamines, *Adaptation, *Drought resistance, Drought effects, Roots, Plant physiology, Plant tissues, Putrescine, Spermidine, Spermine, Arginine, Ornithine, Irrigation, Dehydration.

Changes in polyamines (putrescine, spermidine, spermine) and precursors (arginine, ornithine) were followed during the adaptive morphogenetic response to drought in rape species (Brassica napus L. var. oleifera Metz). Plants were grown during the vegetative stage, under different conditions: watering, progressive soil drying inducing short roots initiation, and rehydration. The analyses were performed separately in aerial parts, whole subterranean organs and in the excised short roots. Whereas no metabolic changes were noticed in the plants regularly watered, some modifications occurred in the plants subjected to progessively increasing water deficit, which could be correlated with the morphological and physiological changes observed at the whole plant level: increased in the precursor (arginine and ornithine) content which appeared concomitantly with the decline in putrescine content at a threshold value of water potential. On rehydration, the increase in precursor content and the decline in putrescine were stopped, suggesting that enzymatic activities of arginine decarboxylase and ornithine decarboxylase, inhibited during the drought period, could resume rapidly. In the short drought-induced roots, the polyamine and precursor content remained constant and at a higher level than in root system of watered plants, during the whole period of drought. The short roots appear as a system undergoing high metabolic activity, capable of withstanding severe drought conditions and thus representing the adaptive potential of the plant. (Author's abstract)
W85-02338

DIURNAL COURSE OF PLANT WATER POTENTIAL, STOMATAL CONDUCTANCE AND TRANSPIRATION IN A PAPYRUS (CYPERUS PAPYRUS L.) CANOPY,
Trinity Coll., Dublin (Ireland). Dept. of Botany.
M. B. Jones, and F. M. Muthuri.
Oecologia, Vol. 63, No. 2, p 252-255, August, 1984. 3 Fig, 15 Ref.

Descriptors: *Papyrus, *Lake Naivasha, *Kenya, *Plant water potential, *Stomatal conductance, *Transpiration, Plant physiology, Water potentials, Wetlands, Swamps, Vapor pressure, Iron.

The diurnal course of water potential, stomatal conductance and transpiration was measured on mature umbels (the major evaporating surface) of papyrus (Cyperus papyrus L.) growing in a fringing swamp on Lake Naivasha, Kenya. Umbel water potential declined only slightly during the morning but fell rapidly after midday to a minimum value of -1.5 M Pa in early afternoon. The two main structures forming the umbels - the bracteoles and rays - showed similar patterns of change of stomatal conductance throughout the day. The values of conductance indicate major stomatal opening during the morning, partial midday closure and some recovery of opening during the afternoon. It appears that the increase in water vapor pressure deficit of the air is the major cause of the midday closure of the stomata and that plant water potential has little effect. The reason why transpiration is reduced at high vapor pressure deficits when water is freely available to the roots is not clear. However, it is speculated that the restricted water movement into the plant from the anaerobic root environment has the effect of reducing the uptake of toxic ferrous iron. The daily total of canopy transpiration is estimated to be 12.5 mm, twice the value previously reported for papyrus but similar to daily values determined for other wetland communities. (Author's abstract)
W85-02341

INTRASPECIFIC COMPETITIVE EFFECTS ON WATER RELATIONS, GROWTH AND REPRODUCTION IN ENCELIA FARINOSA,
Utah Univ., Salt Lake City. Dept. of Biology.
J. R. Ehleringer.
Oecologia, Vol. 63, No. 2, p 153-158, August, 1984. 6 Fig, 3 Tab, 22 Ref. NSF grant 83-13136.

Descriptors: *Incienso, *Competition, *Plant populations, *Plant growth, *Plant reproduction, *Desert plants, *Sonoran desert, Plants, Plant tissues, Leaves, Water requirements, Population density, Deserts, Leaf water potential.

An experiment was conducted to assess the importance of intraspecific competition on water relations, growth and repoductive output in Encelia farinosa, a common deciduous-leaved shrub of the Sonoran Desert. Nearest neighbor analyses in monospecific stands indicated that plants exhibited a clumped distribution. Plant size and nearest neighbor distance were positively correlated, inferring intraspecific competition. Removal experiments monitored for two years indicated that plants now without neighbors had higher leaf water potentials, higher leaf conductances, and a greater leaf area than control plants. As a consequence, growth rates and reproductive output were significantly higher in plants without neighbors. These data strongly support the notion that warm desert plants with a contagious spatial distribution compete for water. (Author's abstract)
W85-02342

PERIPHYTIC OXYGEN PRODUCTION IN OUTDOOR EXPERIMENTAL CHANNELS,
Michigan Univ., Ann Arbor. Dept. of Environmental and Industrial Health.
P. G. Meier, and D. W. Dilks.
Water Research, Vol. 18. No. 9, p 1137-1142, 1984. 5 Fig, 4 Tab, 13 Ref.

Descriptors: *Primary productivity, *Oxygen, *Streams, *Chlorophyll a, Periphyton, Aquatic plants, Light intensity, Water currents, Velocity.

Oxygen production was quantified as a function of chlorophyll a in outdoor experimental channels. Variables investigated included a range of light intensities and four current velocities incorporated through the use of a factorial design. Physical reaeration rates for correcting overall oxygen increases were also determined. Stream velocity was found to be statistically insignificant in affecting oxygen production, but was a factor in periphyton accrual and species composition. Gross oxygen production exceeded respiration by a factor of three. (Baker-IVI)
W85-02432

COMMON RELATIONSHIP BETWEEN PRECIPITATION AND GRASSLAND PEAK BIOMASS FOR EAST AND SOUTHERN AFRICA,
California Univ., Berkeley. Dept. of Zoology.
For primary bibliographic entry see Field 2B.
W85-02544

EPILITHIC AND EPIPELIC DIATOMS IN THE SANDUSKY RIVER, WITH EMPHASIS ON SPECIES DIVERSITY AND WATER POLLUTION,
Bowling Green State Univ., OH. Dept. of Biological Sciences.
For primary bibliographic entry see Field 2E.
W85-02545

PRIMARY PRODUCTION IN RATTLESNAKE SPRINGS, A COLD DESERT SPRING-STREAM,
Battelle Pacific Northwest Labs., Richland, WA. Environmental Sciences Dept.
For primary bibliographic entry see Field 2E.
W85-02547

EFFECTS OF CANOPY COMPONENTS ON THROUGHFALL CHEMISTRY: AN EXPERIMENTAL ANALYSIS,
Dartmouth Coll., Hanover, NH. Dept. of Biological Sciences.
For primary bibliographic entry see Field 2K.
W85-02560

RESPONSES OF STOMATA AND LEAF GAS EXCHANGE TO VAPOUR PRESSURE DEFICITS AND SOIL WATER CONTENT, I. SPECIES COMPARISONS AT HIGH SOIL WATER CONTENTS,
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia).
For primary bibliographic entry see Field 2D.
W85-02561

SEASONAL PHYSICAL, CHEMICAL AND ALGAL CHANGES IN FIVE RIVERS FLOWING THROUGH THE OIL SANDS REGION OF ALBERTA, CANADA,
Alberta Univ., Edmonton. Dept. of Botany.
For primary bibliographic entry see Field 2E.
W85-02562

MICROELECTRODE STUDIES OF INTERSTITIAL WATER CHEMISTRY AND PHOTOSYNTHETIC ACTIVITY IN A HOT SPRING MICROBIAL MAT,
Montana State Univ., Bozeman. Dept. of Microbiology.
For primary bibliographic entry see Field 2K.
W85-02593

2J. Erosion and Sedimentation

FIFTY YEARS OF SEDIMENTATION,
California Inst. of Tech., Pasadena.
V. A. Vanoni.
Journal of Hydraulic Engineering, Vol. 110, No. 9, p 1022-1057, August, 1984. 13 Fig, 1 Tab, 169 Ref.

Descriptors: *Sedimentation, *History, Sediment transport, Entrainment, Erosion, Reviews, Bed load, Suspended sediments, Scour.

The development of sedimentation is traced from the 1930s through the 1970s with key contributions being cited. The term sedimentation includes the processes of erosion, entrainment, transportation, deposition, and compaction of sediment. Much of the research in the early decades of this century dealt with the development of relations for transport of bed load by streams. The developments in the mechanics of turbulent flow which occurred in

the early decades of this century were brought to bear on the problem of sediment suspension in the late 1930s. First experiments on local scour were made in 1940 in a study of the scour of sand by vertically oriented jets. Basic studies of bed forms and bed form predictors are cited. A primary objective in sedimentation is to develop relations which will give sediment discharge in terms of hydraulic parameters and bed sediment characteristics. In the 1940s workers concentrated on developing expressions for discharge of bed load in which the hydraulic variable is the shear stress. More recently, workers have concentrated on developing what are called total sediment discharge relations, some of which apply the theory of suspension or concepts related to it. Additional work in the following areas is also cited: hydraulic relations, effect of water temperature, hydraulic geometry, and stream forms. (Baker-IVI)
W85-02263

AGGRADATION AND DEGRADATION OF ALLUVIAL-CHANNEL BEDS,
W. F. Jaramillo, and S. C. Jain.
Journal of Hydraulic Engineering, Vol. 110, No. 8, p 1072-1085, August, 1984. 9 Fig, 14 Ref. NSF grant CEE80-23003.

Descriptors: *Model studies, *Alluvial rivers, *Aggradation, Channels, Sedimentation, Accretion, Sediment transport, Rivers.

Most rivers are subject to some kind of control or disturbance that gives rise to nonequilibrium flow conditions. A nonlinear parabolic model for nonequilibrium processes in alluvial rivers is presented. Analytical expressions for the characteristic parameters of relevant aggradation and degradation processes are derived. The model can be considered an accurate tool for predicting one-dimensional nonequilibrium processes in alluvial channels due to a sudden variation in sediment-transport rate at the upstream end of the stream. It is applicable to both aggradation and degradation processes in which the relative variation in sediment discharge ranged between -1 and 1. The agreement between the nonlinear analytical solution and the available experimental data is good. (Baker-IVI)
W85-02265

TIDAL PHASE CONTROL OF SEDIMENT DISCHARGE FROM THE YANGTZE RIVER,
Woods Hole Oceanographic Institution, MA.
J. D. Milliman, Y. Hsueh, D.-X. Hu, D. J. Pashinski, and H.-T. Shen.
Estuarine, Coastal and Shelf Science, Vol. 19, No. 1, p 119-128, July, 1984. 5 Fig, 3 Tab, 12 Ref. Office of Naval Research contract N00014-81-C-0009.

Descriptors: *Yangtze River, *China, *Sediment discharge, *Tidal effects, *East China Sea, Estuarine environment, Spring tides, Neap tides.

In the Yangtze River estuary in eastern China, tidal phase plays a major role in controlling sediment discharge. During 1980 and 1981 the flux of water and dissolved/suspended solids from the river into the East China Sea was studied as part of a broader study of the sediment dynamics in the region. Direct measurements indicate that during spring tide in mid-November 1981 approximately 3 times the sediment passed down the main channel of the river as during the next neap tide, 3 days later. The estuary presumably acts as a conduit for riverine sediment during spring tide but as a sink during neap tide. The ratio of spring to neap transport is somewhat less than for other estuaries that have been studied; this results from a smaller difference in spring-neap tidal ranges (volumes) relative to estuarine depth (volume), rather than river discharge or absolute tidal range. Tidal phase control of sediment discharge can occur in microtidal estuaries if the difference between spring and neap tidal range is sufficiently great compared to mean estuarine depth. (Collier-IVI)
W85-02292

RELATING RAINFALL EROSIVITY FACTORS TO SOIL LOSS IN KENYA,
Office of International Cooperation and Development (USDA), Washington, DC.
L. G. Ulsaker, and C. A. Onstad.
Soil Science Society of America Journal, Vol. 48, p 891-896, 1984. 1 Fig, 3 Tab, 46 Ref.

Descriptors: *Soil erosion, *Rainfall, *Kenya, *Soil management, Water loss, Alfisol, Erosion, Erodibility, Climate, Rainfall intensity.

Runoff plots were established on a representative soil site in Kenya in 1980 to evaluate soil and water losses as influenced by climate, soil, and management practices. Fifteen erosivity factors were regressed to ascertain best fit on the soil loss from 3 fallowed plots for each of 35 storms between March 1982 and April 1983. Two of the best rainfall erosivity factors with their respective coefficients of determination are: total kinetic energy times maximum 30-min intensity (EI sub 30), r squared = 0.69, and rainfall amount times the maximum 30-min intensity (AI 30), r squared = 0.72. A regression equation was developed relating EI 30 to rainfall amount, A. The coefficient of determination was 0.902. Soil erodibility for this Alfisol was found to be 0.0314 tonne hectare hour per hectare megajoule millimeter or 0.24 in customary English units. Erodibility factor values ranged from 0.07 for storms producing soil losses less than 1 t/ha to 0.55 for storms producing soil losses greater than 10 t/ha. (Author's abstract)
W85-02322

SOIL AND WATER LOSSES AS AFFECTED BY TILLAGE AND MANURE APPLICATION,
Wisconsin Univ.-Madison. Dept. of Soil Science.
D. H. Mueller, R. C. Wendt, and T. C. Daniel.
Soil Science Society of America Journal, Vol. 48, p 896-900, 1984. 1 Fig, 4 Tab, 26 Ref. EPA grant G001359-01.

Descriptors: *Tillage, *Water loss, *Soil erosion, *Manure, Rainfall, Runoff, Best management practices, Crop residue.

Little data are available on conservation tillage under field conditions characteristic of a dairy operation. Thus, simulated rainfall was used to compare soil and water losses among conventional, chisel, and no-till systems for corn both with and without surface-applied manure prior to tillage. Rainfall was applied at several times during the growing season of 1978 and 1979. A portion of the previous year's crops residue was removed in 1978 and all the residue was left in 1979. A tillage x date interaction was observed for runoff losses in both years of the experiment. Significantly lower runoff occurred for the conventional and chisel systems relative to the no-till system immediately after planting. At later sampling periods, runoff significantly increased for the conventional system and runoff losses approached that from no-till. In contrast, lower runoff losses occurred for the chisel system relative to the other tillage systems. This was most apparent in 1979 when more residue was partially incorporated or left on the soil surface. Surface spread manure decreased runoff for all tillage treatments at the September 1978 sampling period and at both sampling periods in 1979. The results indicated the greatest response with the chisel system. In 1978 and 1979, a tillage x manure interaction was observed for the soil loss. In 1978, little difference in soil loss was observed among unmanured tillage treatments. However, the application of manure reduced soil losses for chisel and no-till systems relative to the conventional system. In 1979, soil losses were lower from unmanured chisel and unmanured no-till treatments than from the unmanured conventional treatment. Soil losses were significantly lower from the manured chisel treatment than all other treatments. (Author's abstract)
W85-02323

SEWERMAN AND THE SCIENTIST; A PARABLE FOR THE ACADEMIC FOLLOWING A COURSE OF DECONTAMINATION (L'EGOUTIER ET LE SAVANT; CONTE MORAL POUR UNIVERSITAIRE EN CURE D'ASSAINISSEMENT),
Institut National Polytechnique, Toulouse (France).
For primary bibliographic entry see Field 5D.
W85-02351

NITROGEN AND PHOSPHORUS IN THE SEDIMENTS OF A TIDAL, FRESHWATER MARSH IN MASSACHUSETTS,
Marine Biological Lab., Woods Hole, MA. Ecosystems Center.
W. B. Bowden.
Estuaries, Vol. 7, No. 2, p 108-118, June, 1984. 6 Fig, 2 Tab, 25 Ref.

Descriptors: *Nitrogen, *Marsh, *Sediments, *Phosphorus, *Massachusetts, Ammonium, Mineralization, Transpiration, Diffusion, Advection, Interstitial water.

Cores for sediment and pore water analyses were taken from a small tidal, freshwater marsh at the head of the North River, between Hanover and Pembroke, Massachusetts. The marsh sediments lie on glacial till, 20 km upstream from the mouth of the North River. The sediments were waterlogged and highly organic. Organic nitrogen content did not change dramatically with depth. Sediments contain from 1.59 to 1.93% N on a dry weight basis. Ammonium concentrations decreased with depth but were always greater than nitrate concentrations. The depth distribution of ammonium is probably maintained by a dynamic balance between net microbial mineralization of litter, plant uptake, transpiration, diffusion, and porewater advection. Total organic phosphorus decreased steadily down to 20 cm. The TON:TOP ratio increased linearly from 14:1 at the surface to 32:1 at 20 cm and was then nearly constant to 70 cm. Phosphorus may be recycled less efficiently than nitrogen. Over time, proportionately more nitrogen than phosphorus may be incorporated into recalcitrant compounds. Phosphorus may also be more mobile than nitrogen in these marsh sediments. (Baker-IVI)
W85-02395

SEDIMENTATION CYCLE OF A FRESHWATER TIDAL FLAT IN THE ST. LAWRENCE ESTUARY,
Laval Univ., Quebec. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2L.
W85-02396

DISTRIBUTION AND SEVERITY OF TUNNEL GULLY EROSION IN NEW ZEALAND,
Ministry of Works and Development, Christchurch (New Zealand). Hydrology Centre.
I. H. Lynn, and G. O. Eyles.
New Zealand Journal of Science, Vol. 27, No. 2, p 175-186, 1984. 3 Fig, 7 Tab, 34 Ref.

Descriptors: *Gully erosion, *New Zealand, Land use, Climates, Erosion.

Data from the New Zealand Land Resource Inventory are used to describe the extent and severity of tunnel gully erosion in New Zealand. The total area of 428,000 ha (328,700 ha in the North Island and 99,300 ha in the South Island) within which tunnel gully erosion was reported is 1.6% of the total land area. Tunnel gully erosion in the North Island occurs mainly on sandstone and mudstone lithologies with yellow-brown earth group soils. In the South Island it is recorded mostly on loess-mantled slopes with yellow-grey earth group soils. Slopes of 16 to 35 degrees are affected the most. Two readily identifiable climatic zones contain tunnel erosion, sub-humid to semi-arid and humid. At least 4 distinctive environments were noted as areas of tunnel erosion: loess and mixed loess colluvium in sub-humid to semi-arid climates; soils derived from strongly weathered sedimentary rocks in humid climates; tephra deposits under a cool humid climate; and colluvial footslope deposits on North Island Tertiary sedimentary hill country with a humid climate. In the Northern Island tunnel gullies generally occur on less steep slopes than those in the South Island and, except for flow tephra environments, rarely develop into open gullies. (Baker-IVI)
W85-02412

RUNOFF AND EROSION RESPONSE OF RECLAIMED SURFACES,
Agricultural Research Service, Fort Collins, CO.
For primary bibliographic entry see Field 4D.
W85-02449

LIVE-BED SCOUR AT BRIDGE PIERS,
Auckland Univ. (New Zealand). Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W85-02452

LIFT FORCES ON MOVING PARTICLES NEAR BOUNDARIES,
Technical Univ. of Denmark, Lyngby. Inst. of Hydrodynamics and Hydraulic Engineering.
B. M. Sumer.
Journal of Hydraulic Engineering, Vol. 110, No. 9, p 1272-1278, September, 1984. 1 Fig, 1 Tab, 11 Ref.

Descriptors: *Fluid mechanics, *Suspended sediments, *Entrainment, Sedimentation, Roughness coefficient, Turbulence, Open-channel flow.

The determination of lift forces is necessary for the prediction of the entrainment and suspension of sediment particles. This study concerns the lift on a moving particle near the bottom (either smooth or rough) in turbulent open-channel flow. The lift force on a moving particle is calculated at the instant when the particle is lifted up from near the bottom. In the smooth wall case, the lift force appears to reach a weak maximum, and then decreases with the distance from the wall, while, in the rough wall case, it decreases appreciably with the distance from the wall. The lift force increases markedly with increasing bed roughness. The extra effect of rough wall on the lift force tends to disappear with the distance from the wall. (Baker-IVI)
W85-02455

TRANSFER OF PARTICULATE ORGANIC CARBON AND NITROGEN FROM THE YANGTZE RIVER TO THE OCEAN,
Woods Hole Oceanographic Institution, MA.
J. D. Milliman, Q. Xie, and Z. Yang.
American Journal of Science, Vol. 284, No. 7, p 824-834, September, 1984. 8 Fig, 1 Tab, 17 Ref. Office of Naval Research Contract N00014-81-C-0009.

Descriptors: *Sediment transport, *Nitrogen, *Rivers, *Yangtze River, *China, *Organic carbon, *Particulate matter, *Meybecks curve, Asia.

The Yangtze River transports 12 million tons of particulate organic carbon (POC) to the oceans annually, with a computed yield of 6 t/sq km of drainage basin area. Concentrations of POC can exceed 80 mg/L in near bottom waters but generally range from 4 to 40 mg/L throughout the water column. Most POC percentages vary from 1.7 to 4.0%, the percentage decreasing with increasing suspended matter concentration although at lesser gradient than that predicted by Meybeck, (Meybeck, Michel, 1981. River transport of organic carbon to the ocean, in Flux of Organic Carbon by Rivers to the Oceans: U.S. Office of Energy Research, Conf. 8009140, UC-11, p. 219-267; and Meybeck, Michel, 1982. Am. Jour. Sci., v. 282, p 401-450). The divergence from Meybeck's curve may reflect the anthropogenic influence of abnormally high POC concentrations within the Yangtze. If the high POC were the result of extensive farming in the basin, then a higher POC/TSM relation in autumn would be found than in early or late summer, but such is not the case. If there is an anthropogenic input, it is apparently continuous and not necessarily related to agriculture. Conversely, the observed POC trend in the Yangtze may be representative of turbid rivers in general or at least those in Asia which have considerable human influence. If the Yangtze POC-TSM relationship holds for other turbid rivers in Asia and Oceania, then the POC transport of sediment-rich rivers is significantly greater than that calculated by Meybeck by as much as 50%. (Baker-IVI)
W85-02467

MEANDERING-BRAIDED RIVER THRESHOLD: A REAPPRAISAL,
McGill Univ., Montreal (Quebec). Dept. of Geography.
For primary bibliographic entry see Field 2E.
W85-02492

TURBID BOTTOM WATER LAYER AND BOTTOM SEDIMENT IN THE SETO INLAND SEA,
Government Industrial Research Inst., Tosu (Japan).
K. Kawana, and T. Tanimoto.
Journal of the Oceanographical Society of Japan, Vol. 40, p 175-183, 1984. 8 Fig, 4 Tab, 26 Ref.

Descriptors: *Suspended solids, *Turbidity, *Seto Inland Sea, *Japan, Vertical distribution, Resuspension, Particle size, Bottom sediments, Organic matter, Carbon, Nitrogen, Tidal currents.

Measurement of the vertical distribution of total suspended matter (TSM) was carried out during summer throughout the Seto Inland Sea. TSM concentration near the bottom is influenced significantly by water movement and turbid bottom water is observed in all areas where median grain size (Md phi) of the bottom sediment is more than 4 phi. The high concentration of TSM near the bottom may be due to resuspension of the surface layer of bottom sediments. Comparison of the organic content of the resuspended matter with that of the bottom sediment shows that the resuspended matter contains more organic matter with a lower C:N ratio than the bottom sediment. The C:N ratio of the resuspended matter is similar to that of TSM in the surface layer of the water column. It is thought that TSM in surface waters sinks and settles on the surface of the bottom sediment. This deposited material is then easily resuspended in the water column by tidal currents before becoming permanently incorporated into the bottom sediment. (Author's abstract)
W85-02530

CHANNEL CHANGES FOLLOWING STORM-INDUCED HILLSLOPE EROSION IN THE UPPER KOWAI BASIN, TORLESSE RANGE, NEW ZEALAND,
Oregon State Univ., Corvallis. Coll. of Forestry.
R. L. Beschta.
Journal of Hydrology, Vol. 22, No. 2, p 93-111, 1983. 10 Fig, 36 Ref.

Descriptors: *Erosion, *Upper Kowai Basin, *Torlesse Range, *New Zealand, Storms, Runoff, Chanels, Sediment transport, Sedimentation.

A downstream progression of depositional zones was created in the Upper Kowai Basin during a 1951 storm. Initial deposits were formed by debris flows and other mass failures. These sediments, aong with those from adjacent hillslopes, incised glacial deposits and tributaries, were then reworked by high flows to form additional deposits farther downstream. As distance downstream increased, the widths and lengths of the deposits increased and their depths decreased. Knowledge of this sequential development of depositional zones is fundamental for estimating sediment yields and understanding bed material transport through mountain stream systems. Although flow magnitude affects movement of bed material, sediment availability is an even more significant factor influencing the channel morphology of the Kowai River and its tributaries. (Baker-IVI)
W85-02554

LONG-TERM CHANGES IN CHANNEL WIDTHS OF THE KOWAI RIVER, TORLESSE RANGE, NEW ZEALAND,
Oregon State Univ., Corvallis. Coll. of Forestry.
R. L. Beschta.
Journal of Hydrology, Vol. 22, No. 2, p 112-122, 1983. 4 Fig, 17 Ref.

Descriptors: *Sediment transport, *Erosion, *Kowai River, *Torlesse Range, *New Zealand, Channels, Sediment load, Stream discharge.

Widths of active channels of the lower 20 km of the Kowai River measured on aerial photographs were used to evaluate channel responses to increased sediment availability during 1943 to 1980. Changes in active channel width of the Kowai River for the period 1943 to 1980 suggest the downstream progression of a major wave of bed material sediment. This wave was initiated during the 1951 storm as a result of storm-induced hillslope erosion in the upper reaches of the Kowai River Basin. In 1960, the leading edge of this wave was located at a channel distance of about 11.5 km from the basin divide. As of 1980 the wave of sediment has moved an additional 11 km downstream, and was only 6 km from the Waimakariri River confluence. Thus the leading edge was being translated at an average rate of several kilometers per decade; an indication that considerable lag times occurred between the increase in sediment availability and the resultant downstream channel responses. Although the Kowai River is braided throughout most of its reach, a periodic component in active channel widths was identified. It disappeared as the active channel significantly widened between 1972 and 1980. Relative change in the active channel widths of braided streams can be used as a surrogate variable for indexing aggradation where channel widths are not constrained by bedrock, man-made structures, or resistant banks. (Baker-IVI)
W85-02555

FORMS AND DISTRIBUTION OF CARBON IN SEDIMENTS OF CASTLE LAKE, CALIFORNIA, U.S.A.,
Michigan State Univ., Hickory Corners. W.K. Kellogg Biological Station.
For primary bibliographic entry see Field 2H.
W85-02648

TRACE METAL COMPOSITION OF AND ACCUMULATION RATES OF SEDIMENTS IN THE UPPER GULF OF THAILAND,
Skidaway Inst. of Oceanography, Savannah, GA.
For primary bibliographic entry see Field 5B.
W85-02654

MODEL FOR FLOW IN MEANDERING STREAMS,
Washington Univ., Seattle.
For primary bibliographic entry see Field 2E.
W85-02671

2K. Chemical Processes

STUDIES ON CHEMICAL SPECIES DISSOLVED IN SHALLOW GROUNDWATERS OF ARIMA RHYOLITE STRATA,
Konan Univ., Kobe (Japan). Dept. of Chemistry.
Y. Kusaka, H. Tsuji, Y. Tamari, K. Nishimura, and Y. Fujiwara.
Japanese Journal of Limnology, Vol. 45, No. 2, p 93-99, April, 1984. 12 Fig, 3 Tab, 5 Ref.

Descriptors: *Sanda, *Nishiwaki, *Japan, *Chemical analysis, *Groundwater, *Rhyolite, Water quality, Hydrogen ion concentration, Weathering, Geochemistry.

Chemical species of the shallow groundwaters collected from the Arima rhyolite strata around Sanda and Nishiwaki cities are studied. Since the chemical composition of the igneous effusive rock is reasonably representative of rocks of the chemical crust, the water quality is important from the geochemical and environmental viewpoints. The concentrations of 28 chemical species, pH and ER are determined by conventional chemical and neutron activation analyses. By showing log-normal distribution character of the concentrations, the median value schematically obtained in the frequency distribution curve is proposed as most suitable as the chemical composition of groundwaters in the strata. It is also pointed out that the CO2 weathering process is the most dominant phenomenon controlling the water qualities. (Author's abstract)
W85-02251

SALT LAKES AND THEIR ORIGINS IN XINJIANG, CHINA (IN CHINESE),
Qinghai Inst. of Salt Lake, Xining (China).
For primary bibliographic entry see Field 2H.
W85-02383

WATER QUALITY IMPLICATIONS OF ARTIFICIAL FLOW FLUCTUATIONS IN REGULATED RIVERS,
Loughborough Univ. of Technology (England). Dept. of Geography.
T. R. Foulger, and G. E. Petts.
Science of the Total Environment, Vol. 37, No. 2 and 3, p 177-185, August, 1984. 2 Fig, 1 Tab, 24 Ref.

Descriptors: *Water quality control, *Rivers, *Flow control, Chemical properties, Conductivity, Calcium, Nitrate, Suspended solids, Water resources development, Environmental effects.

Preliminary data collected for seven releases of low solute concentration water from Llyn Celyn into a channel containing water of significantly greater concentration, indicate that changes in water chemistry during wave passage may be more complex than suggested by simple solute balance equations which show that a simple dilution will occur simultaneously with rising stage. The chemical determinands showed peak concentrations immediately prior to peak stage and a lagged dilution. Application of the kinematic-wave theory did not adequately explain the observed data, and it appears that solute variations with discharge, are related to in channel sources, and correlated with the decay of the suspended loads, which lasted on average for 1 hr after a marked peak. This peak is coincident with the attainment of maximum discharge. Sudden changes of water level in regulated rivers are undertaken in response to demands for electricity, irrigation, and flood control. The determination of instream-flow needs for river ecology must consider the acceptable range, rate, and frequency, for flow fluctuation as well as minimum and optimum flows. Due consideration must be given not only to the immediate destructive effects of large magnitude fluctuations but also to the cumulative effects of repeated, relatively low magnitude pulses which, although sublethal, could eliminate a species over time by adversely affecting reproduction or growth, or by favoring a competitor or predator. (Baker-IVI)
W85-02413

REVERSE WEATHERING IN THE CLOSED-BASIN LAKES OF THE ETHIOPIAN RIFT,
Massachusetts Inst. of Tech., Cambridge. Dept. of Earth and Planetary Sciences.
K. L. Von Damm, and J. M. Edmond.
American Journal of Science, Vol. 284, No. 7, p 835-862, September, 1984. 12 Fig, 4 Ta, 42 Ref.

Descriptors: *Reverse weathering, *Closed-basin lakes, *Rift Valley, *Ethiopia, Chemical properties, Clay, Salts, Saline waters, Alkalinity, Evaporation, Calcite, Gypsum, Minerals.

A detailed investigation has been carried out on the chemistry of continental waters including the Rift Valley Lakes of East Africa. For most of the system, the hydrology is simple and well defined. Evaporative concentration never proceeds to the extent that the chemistry becomes dominated by the precipitation of simple salts. Therefore the effects of fundamentally more important processes of authigenic clay mineral formation can be observed directly. The soluble major ions are being removed on an impressive scale. In closed-basin lakes displaying intermediate degrees of evaporative concentration relative to their inputs the only simple salts that can precipitate are calcite (usually the low-magnesium variety) and minor gypsum. More complex removal processes affecting the major cations and alkalinity can be investigated using mass-balance techniques. Through the application of this process to the lakes of the Ethiopian Rift it is determined that formation of aluminosilicate minerals, reverse weathering, is a major process accounting for over half the alkalinity deficit in the mass balances. The process does not go to completion, however, and alkaline waters result. The reasons such reactions are not important in the oceans is that the maintenance of a relatively low pH by ridge-crest hydrothermal processes in fact precludes their occurrence. (Baker-IVI)
W85-02468

STREAM ECOSYSTEMS IN MOUNTAIN GRASSLAND (WEST CARPATHIANS); 3. CHEMICAL COMPOSITION OF WATER,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
M. Bombowna.
Acta Hydrobiologica, Vol. 24, No. 4, p 321-335, 1982. 4 Fig, 2 Tab, 32 Ref.

Descriptors: *Streams, *Land use, *Water quality control, *West Carpathians, *Poland, Vegetation, Forests, Runoff, Nutrients, Pastures, Erosion, Chemical analysis, Catchments, Phosphates, Nitrogen.

In three mountain streams flowing out of different geological massifs the chemistry of the water was investigated in a two year period. In mountain areas total rainfall is high and plays an important role in the water balance of streams. The flow of stream water affects the load of mineral nutrients and basic cations carried by them. These values varied considerably in different seasons of the year. This pronounced variability of loads throughout the year affected the mean rate of flow of chemical constituents per 1 ha in the different sectors of the Grajcarek catchment basin. A distinct dependence between the geological substratum and the degree of chemical erosion of the chief macroelements was observed. The pastoral use of the catchment basins led to an output of nutritive compounds, while the forest drainage area yielded large amounts of mineral nitrogen compounds. The cumulated fertilization of mountain pastures was reflected by the constant occurrence of phosphates in the stream water and by a pronounced increase in the flow of mineral nitrogen compounds. Permanent pasturing of sheep has been proposed for the investigated catchment basin, hence the cumulated fertilization and, in consequence, increased concentration of nutritive compounds in the water of streams should be taken into consideration. Since large amounts of both ground discharge and runoff appear in the investigated catchment area, the application of fertilizers on frozen soil and before heavy rains should be forbidden. Protective juniper or forest belts between pastures and streams might prevent the flow of suspension and, by using up considerable amounts of nutrients, especially phosphates inhibit their being carried in the streams. (Baker-IVI)
W85-02514

BEHAVIOUR OF PROTEINACEOUS SUBSTANCES IN THE ESTUARY OF THE TAMA RIVER,
Tokyo Univ. of Agriculture and Technology (Japan). Dept. of Environmental Science and Conservation.
For primary bibliographic entry see Field 2L.
W85-02531

EFFECTS OF CANOPY COMPONENTS ON THROUGHFALL CHEMISTRY: AN EXPERIMENTAL ANALYSIS,
Dartmouth Coll., Hanover, NH. Dept. of Biological Sciences.
W. A. Reiners, and R. K. Olson.
Oecologia (Berlin), Vol. 63, No. 3, p 320-330, August, 1984. 6 Fig, 1 Tab, 35 Ref. NSF grant DEB 79-07346.

Descriptors: *Canopy, *Throughfall, *Forests, *Stemflow, Water chemistry, Potassium, Sodium, Nitrates, Ammonium, Rainfall.

To test the influence of various components on throughfall and stemflow chemistry, five canopy components of subalpine balsam fir forests (branches with young needles, branches with old needles, non-foliated twigs, lichen-covered twigs, and boles) were treated with simulated rain. Effects on the fluxes of potassium, sodium, hydrogen, sulfate, nitrate, and ammonium ions by the canopy components were tested in relation to rain application rate, duration of rain, and time since the last rain. Complex interactions were noted between the ionic behavior and components. The ionic behavior generally ranged from high levels of net efflux to mixed influx-efflux to high levels of influx in the order: sulfate, potassium, sodium, nitrate, hydrogen, ammonium. Net flux rates increased with application rate in cases in which application rates produced significantly different results. Branch components mostly ranged from low flux rates to high rates according to the order: young needles < old needles < twigs < lichen-covered twigs. (Baker-IVI)
W85-02560

MICROELECTRODE STUDIES OF INTERSTITIAL WATER CHEMISTRY AND PHOTOSYNTHETIC ACTIVITY IN A HOT SPRING MICROBIAL MAT,
Montana State Univ., Bozeman. Dept. of Microbiology.
N. P. Revsbech, and D. M. Ward.
Applied and Environmental Microbiology, Vol. 48, No. 2, p 270-275, August, 1984. 5 Fig, 30 Ref. NSF grant DEB-8023341.

Descriptors: *Hot springs, *Microbial mats, *Photosynthesis, Dissolved oxygen, Hydrogen ion concentration, Synechoccus, Chloroflexus, Bacteria, Cyanophyta, Solar radiation, Diurnal variation, Primary productivity.

Microelectrodes were used to measure oxygen, pH, and oxygenic photosynthetic activity in a hot spring microbial mat (Octopus Spring, Yellowstone National Park), where the cyanobacterium Synechoccus lividus and the filamentous bacteria Chloroflexus aurantiacus are the only known phototrophs. The data showed very high biological activities in the topmost layers of the microbial mat, resulting in extreme values for oxygen and pH. At a 1-mm depth at a 55 C site, oxygen and pH reached 900 micro M and 9.4, respectively, just after solar noon, whereas anoxic conditions with pH of 7.2 were measured before sunrise. Although diurnal changes between these extremes occurred over hours during a diurnal cycle, microbial activity was great enough to give the same response in 1 to 2 min after artificial shading. Oxygenic photosynthesis was confined to a 0.5- to 1.1-mm layer at sites with tempetatures at or above about 50 C, with maximum activities in the 55 to 60 C region. The data suggest that S. lividus is the dominant primary producer of the mat. (Author's abstract)
W85-02593

CHARACTERIZATION OF PARTICULATE AND COLLOIDAL PHOSPHORUS FORMS IN WATER BY CONTINUOUS FLOW DENSITY GRADIENT CENTRIFUGATION,
Uppsala Univ. (Sweden). Limnologiska Institutionen.
For primary bibliographic entry see Field 2H.
W85-02614

TRANSFERS BETWEEN FORMS OF SEDIMENTARY PHOSPHORUS INDUCED BY NITRATE TREATMENT,
Uppsala Univ. (Sweden). Limnologiska Institutionen.
For primary bibliographic entry see Field 2H.
W85-02621

CALCULATION OF PHOSPHORUS AND NITROGEN LOADINGS TO NATURAL AND ARTIFICIAL LAKES,
Iowa State Univ., Ames. Dept. of Animal Ecology.
For primary bibliographic entry see Field 2H.
W85-02622

CHEMICAL CHARACTERISTICS OF SEVERAL INLAND WATERS IN AFGHANISTAN,
National Inst. for Environmental Studies, Tsukuba (Japan).
Y. Ambe.

Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 1, p 289-295, July, 1984. 3 Fig, 3 Tab, 5 Ref.

Descriptors: *Groundwater, *Rivers, *Afghanistan, *Chemical composition, Chlorides, Sulfates, Bicarbonates, Metals, Precipitation, Groundwater, Alkaline waters, Climate, Topography, Geology.

The general chemical components of the inland waters of Afghanistan are described and the relationship of this chemical composition to the environment is considered. Most of the rivers of the country have their origin in the central mountain region and run toward the periphery of the country. The average annual precipitation is about 300 m at Kabul and most of the rain falls in winter to early spring. Evaporation is high and irrigation is needed to farm the land. The highest values of dissolved components observed for river water were found at Qaleh-nau on River Mogol and at Akcha for groundwater. Both showed a predominance of Ca, Mg and sulfate and well as sodium and chloride. All the waters had alkaline properties with the value of pH being 7.2 - 8.2. Extremely high concentrations of total ions in river water appears only in the area below 1000 m. At present no remarkable effect due to human activity has been found in the quality of inland water in Afghanistan; it lies mainly under the influence of the arid climate, soil and other geographical conditions. The river and groundwaters are characterized by their high concentrations of Ca and HCO3(-) and the other components are diversified by local geological and hydrological conditions. The topography of the land is an important factor. High concentrations of ions were found in rivers in the lowland area. (Baker-IVI)
W85-02628

SULFATE IN AFRICAN INLAND WATERS: SULFATE TO CHLORIDE RATIOS,
P. Kilham.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 1, p 296-302, July, 1984. 1 Fig, 24 Ref. NSF grants GB-8328X and OCE81-17377.

Descriptors: *Sulfates, *Chlorides, *Chemical composition, *Africa, Biogeochemistry, Natural waters, Maar lakes, Saline lakes, Lakes, Rivers, Precipitation, Rocks, Weathering.

Sulfate versus chloride concentrations are plotted for 400 African waters. Sulfate to chloride ratios in these waters can be used to distinguish between atmospheric precipitation and rock weathering as sources of sulfate. This study demonstrated that sulfate in headwater streams is largely derived from rock weathering. The biogeochemical processes that remove sulfate and lower sulfate/chloride ratios are of particular importance in natural waters because the net biological uptake of sulfate results in the production of permanent alkalinity. Sulfate is primarily lost from these freshwater environments as organic-S compounds, which either remain intact or undergo diagenesis to eventually form pyrite. In studying the loss of sulfate sulfur in 11 of the maar lakes that comprise the Basotu Lake District in Tanzania, sulfate is reduced to sulfide before it is lost to the atmosphere as hydrogen sulfide or precipitated as metal sulfides. One outstanding feature of the sulfate/chloride ratios of most of the saline lakes is that they are usually less than one order of magnitude lower than that of their presumed parent waters. Seven of the eight shallow lakes in the Katwe Volcanic Field are highly concentrated. These lakes differ from most of the other saline lakes in East Africa because minerals containing sulfate precipitation from them. Lake Kitagata has an exceptionally high sulfate/chloride ratio of 3:1. (Baker-IVI)
W85-02629

MEASUREMENT OF OPERATIONALLY DEFINED LEAD FRACTIONS IN SEDIMENTS FROM SEVERAL LAKES,
Trent Univ., Peterborough (Ontario).
For primary bibliographic entry see Field 5B.
W85-02632

ALUMINUM SPECIATION IN SURFACE WATERS ON THE CANADIAN PRE-CAMBRIAN SHIELD,
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
P. G. C. Campbell, R. Bougie, A. Tessier, and J.-P. Villeneuve.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 1, p 371-375, July, 1984. 2 Fig, 1 Tab, 10 Ref.

Descriptors: *Surface waters, *Aluminum, *Chemical speciation, *Precambrian shield, Acidity, Thermodynamics, Acid rain, Water quality.

Aluminum introduced into the aquatic environment through acidification of the environment will be partitioned among various possible physicochemical forms. The resultant speciation will influence the subsequent geochemical behavior of the metal and its biological availability. A simple analytical method is presented for determining the speciation of aluminum in freshwaters inherently sensitive to acid precipitation. The procedure was tested on a variety of natural waters to relate the experimentally determined Al speciation to various other water quality parameters and to compare this speciation with that calculated from thermodynamic equilibrium considerations. The speciation procedure allows one to distinguish among different forms of aluminum on the basis of both their physical state and their kinetic and thermodynamic properties. A considerable range of total aluminum concentrations was observed for each group of lakes. The higher concentrations of aluminum were generally associated with low pH readings. Relatively little of this aluminum was present in acid-extractable particulate form. The major portion of the nonexchangeable Al initially appears to be associated with organic matter. (Baker-IVI)
W85-02634

ORIGIN AND DISTRIBUTION OF CARBON DIOXIDE IN THE UNSATURATED ZONE OF THE SOUTHERN HIGH PLAINS OF TEXAS,
Geological Survey, Reston, VA.
W. W. Wood, and M. J. Petraitis.
Water Resources Research, Vol. 20, No. 9, p 1193-1208, September, 1984. 13 Fig, 4 Tab, 58 Ref.

Descriptors: *Carbon dioxide, *Geochemistry, *Aeration zone, *High Plains, *Texas, Groundwater recharge, Carbonates, Microorganisms, Caliche, Ogallala aquifer, Playa lakes.

The partial pressure of carbon dioxide gas in the unsaturated zone is a major control on the carbonate chemistry of recharge water to an aquifer as well as on the deposition and solution of carbonate minerals in the recharge area. Partial pressures of CO2, O2, N2, and Ar were monitored at two locations near playas on the Southern High Plains of Texas. Samples were collected monthly during parts of 1980-1981 from nine depths ranging from 0.6 to 36 meters below land surface. PCO2 was observed to be greater at depth than in the active soil zone and thus appears to contradict the normal process in which CO2 is generated in the soil zone and diffuses upward to the atmosphere and downward to the water table. The delta C-13 of the CO2 gas was quite uniform and averaged -17.9 per mil. PO2 declined with depth, suggesting in situ generation of CO2 by the oxidation of carbon. The most probable hypothesis was that dissolved and particulate organic carbon introduced by recharging water was oxidized to CO2 by the aerobic microbial community that utilized oxygen diffusing in from the atmosphere. This hypothesis is consistent with the CO2 concentration profile, calculated production profile of CO2, delta C-13 values of CO2 gas, caliche, soil humic acid fraction, and dissolved carbonate in groundwater. Carbonate dissolution is not limited to the near-surface soil zone, a conclusion that explains observed solution permeability and the origin of large cavities in the Ogallala aquifer. The origin of playa lakes on the Southern High Plain may be intimately involved with carbonate dissolution and piping of materials into the unsaturated zone (Moore-IVI)
W85-02661

2L. Estuaries

ABOVE GROUND STANDING CROP AND PRODUCTION OF CAREX GRACILIS CURT. IN A FEN,
Marburg Univ. (Germany, F.R.). Fachbereich Biologie.
M. Droste.
Archive fur Hydrobiologie, Vol. 100, No. 4, p 533-538, July, 1984. 2 Fig, 1 Tab, 12 Ref.

Descriptors: *Wetlands, *Fen, *Sedges, Peat, *Standing crops, Biomass, Trophic level, Primary productivity, Alluvial clay.

Above ground standing crop of Carex gracilis was measured by harvest method at six dates during the growing season. Climatic conditions at the test area were temperate. The fen is situated in a valley; the soil remains wet all year. The eutrophic soil consisted of peat and alluvial clay. Plant biomass reached 1.009 g/sq m of which 807 g/sq m were living biomass in early September. Peak biomass corresponds to yearly net production, the litter amounts to about 800 g/sq m/yr. Ash content of living tissue changed from 6.1% in May to 3.8% in July and to 5.6% in October. The correlation not to the warmest month but to heat units and the high production are regarded to be results of the quite maritime climate of Europe and the fertile soil of the study site. (Baker-IVI)
W85-02242

AMOUNTS OF SUSPENDED SOLIDS AND ELEMENTS TRANSPORTED ANNUALLY FROM THE TAKAHASHI RIVER (JAPAN) TO ESTUARY (IN JAPANESE),
Okayama Univ., Kurashiki (Japan). Inst. for Agricultural and Biological Sciences.
H. Teraoka.
Japanese Journal of Limnology, Vol. 45, No. 2 p 111-115, April, 1984. 3 Fig, 3 Tab, 17 Ref.

Descriptors: *Takahashi River, *Japan, *Suspended solids, *Estuarine environment, *Chemical analysis, Discharge, Rainfall.

Concentrations of suspended solids and discharges were measured in the period from 1975 to 1980 in the Takahashi River systems (111 km long, 2670 sq km drainage basin). The sampling site was 10.4 km up the estuary, where the riverbed averages 0.73 m above sea level. When the flux of suspended solid (g/sec) and the discharge (cu m/sec) were plotted on Y axis and X axis, respectively, the relation Log Y = 2.02 Log X - 0.83 (n = 75, r = 0.94) was found. By substituting the regression line for the daily average discharge, the flux of suspended solid (g/day) was estimated. When discharge increased very greatly as a result of heavy rainfall between June 29 and July 1, 1979, its amount (g/hr) was estimated by substituting the above regression for the hourly average discharge. Thus, the amount of suspended solids transported during 1979 from river to estuary was estimated at 7,500,000 kg/yr (discharge: 1,976,000,000 cu m/yr), while the amount for the day of June 29 reached 28,000,000 kg/day (or 37% of the total). A comparison between the average daily concentrations of elements and their concentrations on the June 29th heavy discharge day was undertaken to fully appreciate the effect of heavy rains. (Author's abstract)
W85-02253

LAGRANGIAN TRANSPORT MODEL FOR ESTUARIES,
Najarian, Thatcher and Associates, Inc., Closter, NJ.
T. O. Najarian, D.-P. Wang, and P.-S. Huang.
Journal of Waterway, Port, Coastal and Ocean Engineering, Vol. 110, No. 3, p 321-333, August, 1984. Maryland Power Plant Siting Program contract P78-81-04.

Descriptors: *Model studies, *Estuaries, *Lagrangian transport, Circulation, Flow pattern, Sediment transport.

The applicability of a two-dimensional transient model for investigations of residual currents in tidal waters is demonstrated. The modeling approach appears more versatile and less restrictive than the analytical solution techniques. Tide induced mean Lagrangian flows in rectangular and in sloping bottom, homogeneous estuaries are landward in the surface layers and seaward in the bottom layers. This flow pattern is opposite to the pattern generated by density induced circulation. Sensitivity analysis made in channels with a bottom sill and quadratic friction result in mean Lagrangian flows that are diverging in the surface layers and converging in the bottom layers. Such a flow pattern is not exhibited when computations are made with linear boundary friction assumption. In channels of small tidal amplitude, mean current is due to the density forcing. The time-varying tidal currents modify only the eddy coefficients. For modest tidal ampitude, mean current is also generated by the nonlinear tidal forcing. The tide-induced current usually opposes density induced current, and it also modifies salinity distribution by advection. The net effect is weak Lagrangian circulation and a more homogeneous vertical salinity profile. Prediction of mean velocity and salinity distribution in estuaries of strong tidal flow must include the joint effects of density and nonlinearity. This is because density and nonlinear tidal forcing are coupled. The formulation of the Stokes velocities are based on the small amplitude displacement approximation. (Baker-IVI)
W85-02270

PATTERNS OF SUSPENDED PARTICLE DISTRIBUTION AND TRANSPORT IN A LARGE FJORDLIKE ESTUARY,
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
E. T. Baker.
Journal of Geophysical Research, Vol. 89, No. C4, p 6553-6566, July, 1984. 14 Fig, 1 Tab, 39 Ref.

Descriptors: *Puget Sound, *Washington, *Suspended sediments, *Estuarine environment, *Sediment transport, Water circulation, Seawater, Turbidity.

Seasonal and spatial patterns of the distribution and transport of suspended particles in Puget Sound, a large fjordlike estuary, are a product of the interaction of the subtidal circulation with surface and bottom particle sources. The particle distribution differs from the distribution of hydrographic properties and is characterized by four persistent features: (1) a thin (< 10 m), high-turbidity surface layer, (2) a thick (approximately 50 m), low-turbidity zone centered around the level of no net motion between net seaward and landward flow, (3) horizontal particle fronts at the sill entrances, and (4) a bottom nepheloid layer maintained by local resuspension. Removal of particles from the surface waters by advective downwelling at the seaward sill and gravitational settling throughout the basin make Puget Sound an efficient particle trap. Particles sedimented on the basin floor are transported preferentially landward by the action of erosion/deposition cycles enhanced by fortnightly intrusions of new marine water. (Author's abstract)
W85-02294

BETTER RATIONALE FOR WETLAND MANAGEMENT,
Nelson (R. Wayne) and Associates, Inc., Boulder, CO.
R. W. Nelson, and E. C. Weller.
Environmental Management, Vol. 8. No. 4, p 295-308, July, 84. 4 Fig, 5 Tab, 41 Ref.

Descriptors: *Wetland management, *Resources management, *Wetlands, Clean Water Act, Natural resources, Resources development, Environmental protection, Environmental impact.

The present US Federal wetland management strategy under Section 404 of the Clean Water Act does not account for the difference in the natural values of wetlands and their different vulnerability to development pressure. The strategy, aimed at reducing the regulatory burden, provides for different levels of wetlands protection, primarily by designating certain activities in or affecting wetlands as essentially harmless, having only minor impacts even when considered for their cumulative effects. Such activities are authorized under general permits precluding any evaluation of project impacts. A sounder, yet practical, rationale for wetland management and regulatory relief should be linked to the scarcity of certain wetland habitats, the habitat diversity or carrying capacity, the degree of degradation from past development, and the incremental losses already incurred within the same wetland ecosystem. The regulatory effort should be concentrated where these characteristics indicate high-value wetlands. Wetland impacts appear to fit into five basic orders of magnitude; these pertain to the relative cost and difficulty of impact mitigation. Up to 13 ecological and public-interest variables can modify the seriousness of the basic impact. Together, the basic orders of impact and modifying variables describe the theoretical framework for wetland managment. However, a practical rationale for better wetland management must be constrained to factors not requiring a field investigation in advance of project planning for construction and development. (Author's abstract)
W85-02295

DIURNAL COURSE OF PLANT WATER POTENTIAL, STOMATAL CONDUCTANCE AND TRANSPIRATION IN A PAPYRUS (CYPERUS PAPYRUS L.) CANOPY,
Trinity Coll., Dublin (Ireland). Dept. of Botany.
For primary bibliographic entry see Field 2I.
W85-02341

ECOLOGICAL STUDIES OF THE MOBARA-YATSUMI MARSH. MAIN PHYSICAL AND CHEMICAL FACTORS CONTROLLING THE MARSH ECOSYSTEM,
Hokkaido Univ., Sapporo (Japan). Dept. of Biosystem Conservation.
K. Yabe, and M. Numata.
Japanese Journal of Ecology, Vol. 34, No. 2, p 173-186, June, 1984. 11 Fig, 3 Tab, 23 Ref.

Descriptors: *Marshes, *Ecosystems, *Physicochemical properties, Wetlands, Japan, Water level, Dissolved oxygen, Succession, Vegetation, Ecology, Swamps, Meadows, Thickets.

The ecosystem in the Mobara-Yatsumi marsh was found to be mainly controlled by the following factors: mean water level, fluctuation of water level, thickness of muck layers and DO of surface water. Of these, mean water level was effective independently, while fluctuation of water level, thickness of muck layers and DO were closely correlated with each other. Among the correlated factors, the most rudimentary factor appeared to be the fluctuation of water level. The successional process was estimated from the relationship between environmental factors and vegetation types. In the process of succession, two types were supposed: the reed swamp - grassy meadow - grass-forb meadow - alder thicket type; and the reed swamp - tussock meadow - alder thicket type. The former occurred under conditions of large fluctuation of water level and underdevelopment of muck layers, but the latter occurred in areas where small fluctuations of water level and thick mucks were observed. The oxidation-reduction potential of soil in the tussock meadow was lower than that in the grassy meadow and the grass-forb meadow. In the process of succession, the tussock meadow maintained the stable phase due to the anaerobic condition of the soil. (Author's abstract)
W85-02381

RELATIONSHIPS BETWEEN ELECTRICAL CONDUCTIVITY, CHLORINITY AND DENSITY OF COASTAL WATERS OF CHINA (IN CHINESE),
Shandong Coll. of Oceanology (China).
X. Min, G. Chen, W. Han, and C. Congjie.
Oceanologia et Limnologia Sinica, Vol. 15, No. 1, p 82-90, 1984. 2 Fig, 9 Tab, 22 Ref.

Descriptors: *Conductivity, *Chlorinity, *Density, *Coastal waters, *China, Mathematical equations, Salinity.

This paper deals with the relationships between electrical conductivity, chlorinity and density of coastal waters of China. The basic equations are as follows: sigma 25 = -2.727 + 1.346 Cl; C(s,25,0) = 5.371 + 2.472 Cl; sigma 25 = -5.660 + 0.545C(s,25,0). When the salinity values are higher than 32.5, the values of density by the Knudsen's Hydrographical Table are a little higher than that of the measured and the values calculated from Cox's equation are much higher than that of the measured. The relationship between salinity and density is closer if the values of salinity and density are calculated directly from the electrical conductivity than from the chlorinity. Taking 53.160 mQ-1/cm as the value of C(35,25,0) in the above equation is appropriate for calculating the values of electrical conductivity of coastal waters of China. (Author's abstract)
W85-02382

NITROGEN AND PHOSPHORUS IN THE SEDIMENTS OF A TIDAL, FRESHWATER MARSH IN MASSACHUSETTS,
Marine Biological Lab., Woods Hole, MA. Ecosystems Center.
For primary bibliographic entry see Field 2J.
W85-02395

SEDIMENTATION CYCLE OF A FRESHWATER TIDAL FLAT IN THE ST. LAWRENCE ESTUARY,
Laval Univ., Quebec. Dept. of Civil Engineering.
J.-B. Serodes, and J.-P. Troude.
Estuaries, Vol. 7, No. 2, p 119-127, June, 1984. 6 Fig, 1 Tab, 22 Ref.

Descriptors: *Tidal flats, *Sedimentation, *St. Lawrence Estuary, *Cap-Tourmente Tidal Flat, *Quebec, Estuaries, Accretion, Seasonal variation, Erosion, Vegetation, Geese.

The Cap-Tourmente tidal flat is located on the north shore of the St. Lawrence middle estuary, 50 km downstream from Quebec city. The annual sedimentological cycle is characterized by very rapid changes which occur during four separate periods. There are two periods of intense erosion in May and October-November which precede and follow a period of very active accretion of approximately 100 days. Of the various factors influencing summer accretion, the most important is the very gradual slope of the upper part of the marsh as it results in a large area which is submerged only at the end of the tidal cycle and therefore is subject to low currents. Vegetation can grow in this part of the flat thereby providing protection against resuspension by tidal currents and wind-induced waves. An unusual factor of erosion is the very large flocks of snow geese which destabilize the sediment cover by walking and probing in the sediment with their beaks, and destroy the protective vegetation cover in a matter of days in the fall. This role of the vegetation in favoring the summer accretion is confirmed by measurements of tidal currents at different positions within the vegetation band in June when the plants are very short and in September when they reach their maximum development. The energy of floods is higher than the ebb resulting in an outflow with a weaker carrying capacity than the inflow. The vegetation modifies the direction of flood currents, orienting them landward, and the direction of ebb current, orienting them perpendicularly to the shoreline. (Baker-IVI)
W85-02396

FOULING COMMUNITY OF THE LOXAHATCHEE RIVER ESTUARY, FLORIDA, 1980-81,
Geological Survey, Tampa, FL.
B. F. McPherson, W. H. Sabanskas, and M. Sabanskas.
Estuaries, Vol. 7, No. 2, p 149-157, June, 1984. 4 Fig, 4 Tab, 19 Ref.

Descriptors: *Estuaries, *Fouling, *Loxahatchee River Estuary, *Florida, Salinity, Temperature effects, Nutrients, Seasonal variation, Barnacles, Mollusks.

The Loxahatchee River estuary is located roughly midway between Biscayne Bay and the Indian

River. It possesses a distinct salinity gradient from freshwater to seawater. Fouling macroinvertebrates belonging to 8 phyla and 10 classes were collected from seawalls, piers, bridges, and mangroves in the estuary. Barnacles and mollusks were the most widely distributed and conspicuous of the fouling macroinvertebrates on these substrates. Hydroids and colonial ascidians were also abundant and conspicuous at some locations. Eight species of barnacles were found, each with a distinct distribution. Some mollusks such as the oyster, Crassostrea virginica, were abundant and widely distributed. Other species had more restricted distributions. The fouling invertebrates that settled and grew on the test panels were predominantly barnacles, hydroids, bryzoans, tube-building amphipods, serpulid polychaetes, and colonial ascidians. Monthly growth varied with season and with location within the estuary. Growth at most sites was lowest in January. Maximum growth occurred during mid-summer to early autumn at the downstream sites, and during late spring or early summer at the upstream sites, before discharge in the river substantially lowered salinity. Periodically low salinity conditions at some test sites inhibited growth cycles. (Baker-IVI)
W85-02398

ZOOPLANKTON ASSOCIATIONS IN THE SWAMPS OF SOUTHERN SUDAN,
Westfield Coll., London (England). Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W85-02406

ANALYSIS OF TIDAL RIVER RECORDS BY A HARMONIC REGRESSIVE TECHNIQUE,
Ministry of Works and Development, Christchurch (New Zealand). Water and Soil Science Centre.
D. G. Goring.
Journal of Hydrology, Vol. 73, No. 1/2, p 21-37, July, 1984. 7 Fig, 3 Tab, 8 Ref.

Descriptors: *Tidal rivers, *Flow, Mathematical equations, Flood forecasting, Frequency analysis, Harmonic regressive technique.

A method for calculating the tidal constituents from a period of tidal record is described. The method uses a harmonic approach which allows it to be applied to records which are not entirely tidal, but have some river flow as well. By transforming the time record to the frequency domain, the river contribution can be separated from the tide. The frequency profile of each constituent that it is wished to identify is computed. Then a least squares method is used to evaluate the coefficients of the profiles which correspond to the amplitude and phase of the tidal constituents. For tidally affected river records, the quarter-diurnal constituents tend to be more important than is the case for pure tidal records. This has the effect of distorting the tidal curve and it is suggested that this is caused by nonlinear shallow-water effects. The tidal constituents calculated by this method may be used to predict the tide during periods of steady flow. During periods of nonsteady flow, such as floods, the predictions may be considerably in error because of nonlinear effects in the interaction of the tide with the river flow. These errors take the form of an over estimation of the water level. For simulation, such as is used in engineering design, this represents a conservative estimate and is probably satisfactory. For real-time flood forecasting, information about the current level of the forecasting site needs to be incorporated into the forecasting algorithm. (Baker-IVI)
W85-02457

PRIMARY PRODUCTION IN GRAYS HARBOR ESTUARY, WASHINGTON,
Corps of Engineers, Seattle, WA. Environmental Resources Section.
R. M. Thom.
Bulletin of Southern California Academy of Science, Vol. 83, No. 2, p 99-105, 1984. 1 Fig, 1 Tab, 28 Ref.

Descriptors: *Primary productivity, *Estuaries, *Grays Harbor Estuary, *Washington, Benthic environment, Algae, Phytoplankton, Eelgrass.

The first estimate is presented of total annual primary production for Grays Harbor estuary. This estuary is a large drowned river mouth located on the Pacific coast of Washington. The estuary is characterized by extensive tideflats, channels, and fringe marshes. Several rivers drain into the estuary, the primary one being the Chehalis River located at the eastern end of the estuary. Tides are semidiurnal with mean range of 2.4 m at Aberdeen. The extensive shallow tideflats are occupied by eelgrass and benthic algae. These vegetation types account for the vast majority of carbon fixation within the estuary annually. The green algal Enteromorpha/Blidingia complex had the greatest rate followed by two marsh assemblage types and the eelgrass Zostera marina. Phytoplankton exhibited the lowest rate. Average annual total primary production in the estuary was estimated to be 260000 kgC/sq km. (Baker-IVI)
W85-02470

SEDIMENT-WATER EXCHANGE IN SHALLOW WATER ESTUARINE SEDIMENTS,
Washington Univ., Seattle. School of Oceanography.
For primary bibliographic entry see Field 5B.
W85-02473

ECOLOGICAL VARIATION OF MIRE SITE TYPES IN THE SMALL KETTLE-HOLE MIRE HEINISUO, SOUTHERN FINLAND,
Finnish Forest Research Inst., Helsinki. Dept. of Peatland Forestry.
A. Reinikainen, T. Lindholm, and H. Vasander.
Annales Botanici Fennici, Vol. 21, No. 1, p 79-101, 1984. 16 Fig, 8 Tab, 100 Ref.

Descriptors: *Peat bogs, *Mire, *Chemical reactions, *Vegetation, *Heinisuo, *Finland, Soil water, Topography, Water analysis, Water level.

Combinations of physical and chemical factors, especially those connected with hydrology and nutrient ecology, are examined in relation to the mire site types and vegetational variation on Heinisuo. Fifteen different mire site types, varying from ombrotrophic to eutrophic, were distinguished on a 3 ha kettle hole mire, Heinisuo, southern Finland. Due to its topograhy and hydrology, Heinisuo has remained in a rather fertile stage throughout its development. The mineral contents were usually in the upper end of the range of values reported from similar site types in larger mires. Due to the fluctuations of the ground water and rapid surface flow, three different groups of mire site types could be separated on the relationship between the thickness of the aerobic peat layer and the depth of the water table. The chemical analyses also revealed intercorrelated groups of elements. The vegetation and site types change along a complex gradient involving both the water level and its fluctuations and the nutrient regime. Due to horizontal water movement, the fertile lagg zone is broad and the ombrotrophic part of the mire is of minor importance. (Baker-IVI)
W85-02485

BEHAVIOUR OF PROTEINACEOUS SUBSTANCES IN THE ESTUARY OF THE TAMA RIVER,
Tokyo Univ. of Agriculture and Technology (Japan). Dept. of Environmental Science and Conservation.
N. Ogura, Y. Tanaka, J. Itoh, and K. Takahashi.
Journal of the Oceanographical Society of Japan, Vol. 40, p 184-191, 1984. 4 Fig, 3 Tab, 19 Ref.

Descriptors: *Estuarine environment, *Proteinaceous substances, *Tama River, *Japan, Mixing, Flocculation, Particulates, Dissolved solids, Salinity, Sea water, Organic matter.

During estuarine mixing, some of the dissolved organic and inorganic matter is removed by flocculation. Behavior of dissolved and particulate proteinaceous substances in the estuary of the Tama River (Japan) was investigated through field observations and laboratory experiments. The Tama River rises in the mountains of Yamanashi Prefecture and runs through the southern part of Tokyo before flowing into Tokyo Bay. Concentrations of dissolved proteinaceous substances in estuarine water were determined at eight stations between the mouth of the Tama River and a point 16 km upstream, and expressed in terms of Folin phenol active substances (FPAS). FPAS decreased with increasing salinity and the proportion of high molecular weight FPAS (molecular weight greater than 100,000) decreased rapidly in the estuary. The shapes, sizes and numbers of amorphous particulate substances stained by Amido Black 10B, called Amido Black active substances (ABAS), were determined under a microscope. The numbers of ABAS retained on Millipore HA filters (mean diameter: 10-80 micro m) amounted to 450/ml in the estuarine water about 6 km from the mouth of the estuary. Some of these aggregates may be produced in situ by flocculation of high molecular weight FPAS during estuarine mixing. ABAS were also produced in experiments by mixing filtered river water with sea water. This process forms an important part of the biogeochemical cycle of organic substances in the estuarine environment. (Moore-IVI)
W85-02531

YEAR-TO-YEAR CHANGE IN WATER EXCHANGE CHARACTERISTICS IN A SEMI-ENCLOSED BAY, LAKE HAMANA,
Tokai Univ., Shizouka (Japan). Faculty of Marine Science and Technology.
Y. Mazda.
Journal of the Oceanographical Society of Japan, Vol. 40, p 199-206, 1984. 9 Fig, 1 Tab, 13 Ref.

Descriptors: *Water exchange, *Bays, *Lake Hamana, *Japan, Salinity, Tidal prism, Model studies, Topography, Turnover time.

The year-to-year change in characteristics of water exchange between Lake Hamana, a semi-enclosed bay, and the adjacent open sea is investigated. The destruction of the bay mouth by a typhoon in 1953 and subsequent stabilization work on the bay mouth from 1954 to 1973 resulted in an increase in the tidal prism volume of the bay (Mazda, Bull. Coast. Oceanogr., 20, 178-188, 1983). In the present paper, a simple model has been constructed in which the magnitude of water exchange depends on the tidal prism, and using this model, the year-to-year increase in salinity of the bay water after 1953 can be well explained. Consequently, it can be said that the salinity increase after 1953 is a result of a progressive increase in water exchange caused by successive changes in topography of the bay mouth. The extent of water exchange in Lake Hamana, which varies seasonally, has increased gradually since 1953, and became stable after about 1967. For instance, at present the turnover time of the bay for exchange with open sea water reaches a maximum (2.9 months) in January and a minimum (0.9 month) in October, while in 1955 it is estimated to have been about 2.5 times that at the present time. (Author's abstract)
W85-02532

EFFECTS OF FLUCTUATIONS IN HYDROGRAPHIC CONDITIONS ON YEAR-CLASS STRENGTH OF AMERICAN SHAD (ALOSA SAPIDISSIMA) IN THE CONNECTICUT RIVER,
Connecticut Dept. of Environmental Protection, Waterford. Marine Fisheries Office.
V. A. Crecco, and T. F. Savoy.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 41, No. 8, p 1216-1223, August, 1984. 4 Fig, 5 Tab, 38 Ref.

Descriptors: *Shad, *Larval growth stage, *Year-class strength, River flow, Water temperature, Precipitation, Zooplankton, Feeding success, Fish stocks, Recruitment.

Year-class strength of Connecticut River shad, Alosa sapidissima, appears to be established by the end of the larval period. It is less certain whether larval survival rates and year-class recruitment are

manly influenced by biotic factors, abiotic factors, or their joint interaction with egg production. A correlation analysis was conducted between the relative strength of the 1966-73 and 1978-82 year-classes and mean monthly river flows, water temperatures, and total monthly precipitation data. Zooplankton densities, hydrographic conditions, and larval feeding success were correlated among the 1979 through 1982 year-classes. There was no significant stock-recruitment relationship using female shad population data from 1966 through 1977. Neither linear nor nonlinear spawner-recruit models could account for more than 6.5% of the variation. When the variation due to June river discharge and water temperature on year-class strength was removed, one model accounted for 11% of the remaining variation, although this was not significant. All three environmental variables (mean river discharge, water temperatures, and total monthly precipitation) were significantly correlated with shad year-class strength for the month of June, the period when most American shad larvae emerge. High June river flows and low river temperatures reduce larval feeding success, survival, and ultimately shad year-class strength, providing a reasonable explanation for the lack of a parent-progeny relationship. (Moore-IVI)
W85-02535

TRANSPORTATION OF WATER, PARTICULATE AND DISSOLVED ORGANIC AND INORGANIC MATTER BETWEEN A SALT MARSH AND THE EMS-DOLLARD ESTUARY, THE NETHERLANDS,
Rijksinstituut voor Natuurbeheer, Leersum (Netherlands).
N. Dankers, M. Binsbergen, K. Zegers, R. Laane, and M. R. van der Loeff.
Estuarine, Coastal and Shelf Science, Vol. 19, No. 2, p 143-165, August, 1984. 7 Fig, 9 Tab, 64 Ref.

Descriptors: *Estuaries, *Salt marshes, *Sediment transport, Storms, Water currents, Ammonia, Phosphates, Silica, Nitrates, Nitrite, Carbon, Organic matter.

Transport processes were studied in a gully between a salt marsh and an estuary. After storm tides, ebb currents in the gully reached high values. Particulate matter (both organic and inorganic) is imported into the marsh. Coarse organic debris is exported during storm tides, but this amount is low when compared with the primary production on the marsh. Exports are shown for dissolved organic carbon, ammonia, phosphate and silica, while nitrate and possibly nitrite are imported. Organic matter derived from in situ production and net import is buried and partly mineralized in the marsh. DOC produced in the marsh is also exported to the estuary. From the inorganic nutrients, ammonia and phosphate are exported and nitrate and nitrite are imported into the marsh, especially in the spring. (Baker-IVI)
W85-02655

FLUXES OF ORGANIC CARBON IN A FJORD ON THE WEST COAST OF IRELAND,
University Coll., Galway (Ireland). Dept. of Microbioloby.
T. G. McMahon, and J. W. Patching.
Estuarine, Coastal and Shelf Science, Vol. 19, No. 2, p 205-215, August, 1984. 4 Fig, 3 Tab, 49 Ref.

Descriptors: *Fjords, *Organic matter, *Carbon, *Ireland, Particulate matter, Carbon cycle, Organic carbon, Rainfall, Productivity.

The supply of particulate organic carbon (POC) via freshwater influx, and its exchange with the open sea, were estimated for a fjord-like coastal inlet, Killary Harbor, Ireland, during 1981. Biological production and destruction of organic matter within the inlet were also studied. Two main sources of POC have been identified for Killary Harbor: the supply of POC from freshwater and the contribution from primary productin within the system. The total input of POC with freshwater was estimated to be 514 tonnes. POC levels in rivers feeding the system were correlated with rainfall. The seasonal trend of primary production and phytoplankton standing crop in temperate waters generally follows a bimodal pattern with a major peak in spring and a minor peak in autumn. This pattern is largely determined by water column stability and the availabiltiy of nutrients. In water bodies receiving inputs of POC from sources other than phytoplankton production, the fluctuations in the standing levels of POC are unlikely to correlated closely with the fluctuations in primary productivity. Carbon to nitrogen ratios suggested an increased portion of POC of terrestrial origin at stations influenced by freshwater inflow, and throughout the fjord in the non-productive season. A tentative annual carbon budget is presented. (Baker-IVI)
W85-02656

NITROGEN AND PHOSPHORUS CONCENTRATIONS WITHIN NORTH INLET, SOUTH CAROLINA - SPECULATION AS TO SOURCES AND SINKS,
South Carolina Univ., Columbia. Belle W. Baruch Inst. for Marine Biology and Coastal Research.
T. G. Wolaver, W. Johnson, and M. Marozas.
Estuarine, Coastal and Shelf Science, Vol. 19, No. 2, p 243-255, August, 1984. 8 Fig, 1 Tab, 19 Ref.

Descriptors: *North Inlet, *South Carolina, *Nitrogen, *Phosphorus *Inlets, Estuaries, Water analysis, Sinks, Tidal effects, Ammonium, Orthophosphate, Nitrates, Nitrites, Marshes.

The daily concentrations of ammonium, orthophosphate, and nitrate + nitrite, are all associated with the stage of the tide during specific times of the year, especially when there is negligible freshwater input. Since there are high concentrations of these constituents during low slack water, there is a source for these constituents within the North Inlet system. Ammonium and orthophosphate most likely have their source in sediment diffusion from tidal creek sediments and/or runoff and seepage from the vegetated marsh surface during tidal exposure, while it is hypothesized that the high nitrate + nitrite values found at low tide are primarily caused by nitrification. In general the source of the dissolved inorganic nitrogen and phosphorus species appears to reside within the tidal creeks and not the vegetated marsh surface. The daily variations of dissolved organic nitrogen (DON) and dissolved organic phosphorus (DOP) have no consistent association with any physical forcing functions. Diffusion of DOP from the tidal creek sediments plus a terrestrial source of DON during rainy periods seems to control the concentrations of these constituents. Particulate nitrogen and particulate phosphorus concentrations are only slightly associated with the stage of the tide. It appears that the source of these constituents resides in wave action which scours the tidal creek banks and the marsh surface, rainstorms during tidal exposure which remove particulate material from the marsh surface via runoff, or high tidal velocities scouring the creek bottom. (Baker-IVI)
W85-02657

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

IONS AND WATER TRANSPORT ACROSS CHARGED NAFION MEMBRANES. IRREVERSIBLE THERMODYNAMICS APPROACH,
Nicolas Copernicus Univ. of Torun (Poland). Inst. of Chemistry.
A. Narebska, S. Koter, and W. Kujawski.
Desalination, Vol. 51, No. 1, p 3-17, July, 1984. 8 Fig, 20 Ref.

Descriptors: *Desalination, *Isotherms, *Membrane processes, *Nafion membranes, Transport, Sodium chloride.

The isothermal transport of ions and water across the perfluorinated Nafion 120 membrane in contact with sodium chloride solutions of concentration 0.05 to 4 mol/l has been studied based on irreversible thermodynamics of transport. The interactions of ions with water and polymer matrix on passing across the membrane are considered on the ground of the resistance coefficients, friction coefficients, coupling coefficients, and mobility indexes. The variations of the coefficients with concentration of an external electrolyte allow comment on the structure-selectivity problems and reflect sensitivity of a cluster like morphology of the membrane to sorption and swelling. At a low concentration range the coefficients reflect the mean resistances or interactions within the membrane with the sorbed sodium chloride located mainly within the clusters. At increased sorption, clusters approach the channels in composition. At that stage an electrolyte is distributed within the membrane more or less uniformly giving different mean interactions for the moving particles with the polymer chains and so different phenomenological coefficients. In this indirect way the transport coefficients seem to confirm the morphology of Nafion membranes. They also stress the sensitivity of the structure to sorption and swelling. (Baker-IVI)
W85-02551

EFFECT OF CRYSTALLINITY AND SWELLING ON THE PERMEABILITY AND SELECTIVITY OF POLYMER MEMBRANES,
Koninklijke/Shell-Lab., Amsterdam (Netherlands).
J. G. A. Bitter.
Desalination, Vol. 51, No. 1, p 19-35, July, 1984. 6 Fig, 17 Ref.

Descriptors: *Desalination, *Membrane processes, *Permeability, *Membranes, Reverse osmosis, Selectivity, Crystallization, Swelling, Polymers.

A simplified procedure is proposed for calculating membrane separation of multicomponent mixtures, which is based on the assumption of an exponential concentration gradient inside the membrane in accordance with reported experimental observation. The exponential form, which differs for each composition and set of conditions, can be calculated from the boundary conditions of the membrane. A number of pervaporation, dialysis and reverse osmosis experiments were performed using several hydrocarbon mixtures and polyolefin membranes. The required basic diffusivities were derived from the pervaporation experiments. From these were calculated the fluxes and selectivities of the components for the different modes of membrane operation. The various parameters of the different permeants in the mixtures are coupled through mathematical equations and this forms the basis for the influence of mixture compostion on flux and selectivity. The data relate to a system with pure permeants on either side of the membrane. The theoretical model is able to predict coupled transport without the introduction of a semi-empirical coupling coefficient as is required in more conventional approaches. (Baker-IVI)
W85-02552

NEW THIN-FILM COMPOSITE REVERSE OSMOSIS MEMBRANES AND SPIRAL WOUND MODULES,
Nitto Electric Co. Ltd., Osaka (Japan).
Y. Kamiyama, N. Yoshioka, K. Matsui, and K. Nakagome.
Desalination, Vol. 51, No. 1, p 79-92, July, 1984. 11 Fig, 7 Tab, 7 Ref.

Descriptors: *Desalination, *Membrane processes, *Membrane filters, Reverse osmosis, Membranes, Brackish water, Seawater.

Two new series of thin-film composite reverse osmosis membranes have been developed and fabricated into spiral wound modules. The NTR-7100 series membrane is able to desalt sea and brackish water. The NTR-7250 membrane is designed for use at pressures below 20 kg/sq cm. The membrane has a very high water permeability and is resistant to chemical and microbiological attack. In particular, the membrane is stable to chlorine, as shown by long-term reverse osmosis tests with tap water containing about 1 ppm of residual chlorine. The membrane has an unusual pattern of solute rejection. Salts containing divalent anions, such as sodium sulfate or magnesium sulfate, are rejected more than 98% while salts with monovalent anions

and bivalent cations, such as magnesium chloride, are rejected about 90% and salts with monovalent anions and cations, such as sodium chloride, are rejected 30-50%. Neutral solutes have relatively high rejection; for example, glucose at 90% and sucrose at less than 99%. Thus the NTR-7250 membrane provides high fluxes and low operating pressures, fair rejection of monovalent ions, good rejection of divalent ions, good rejection of organics, excellent chlorine resistance, and good temperature stability. NTR-7250 membranes should find applications in brackish water desalting, water softening, ultrapure water recovery, concentration of fermentation products, and concentration of valuable products by desalination. (Baker-IVI)
W85-02553

3F. Conservation In Agriculture

NEW CROPS FOR ARID LANDS,
Arizona Univ., Tucson.
C. W. Hinman.
Science, Vol. 225, No. 4668, p 1445-1448, September 1984. 20 Ref.

Descriptors: *Arid lands, *Crop production, Plants, Economic aspects.

Five plants are described that could be grown commercially under arid conditions. Once the most valuable component has been obtained from each plant the remaining material holds potential for useful products as well as fuel. The four crops with their most valuable component are guayule which yields rubber; jojoba, seed oil; bladderpod, buffalo gourd; and gumweed, resin. The single-product orientation inherited from present-day agriculture and the chemical industry must change if the arid land crops are to become an economic reality. Certain plants must be viewed as multiple product resources. Perhaps the greatest deterrent to rapid development of these plants is that the research sponsor must be concerned with too many diverse problems: growing, harvesting, and transporting plant material and then processing it into multiple products. (Baker-IVI)
W85-02548

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

DETERMINATION OF OPTIMUM MINIMUM FLOW FROM A DAM BY USING ENERGY ANALYSIS,
South Carolina Univ., Columbia. Dept. of Environmental Health Sciences.
J. B. Williams, and H. N. McKellar, Jr.
Environmental Management, Vol. 8, No. 4, p 345-352, July, 1984. 5 Fig, 5 Tab, 13 Ref.

Descriptors: *Connecticut, *Quinebaug River, *Minimum flow, *Energy analysis, *Dams, *Hydrolelectric plants, Productivity, Aquatic productivity, Aquatic habitats, Flow.

The proposed restoration of an abandoned hydroelectric dam on the Quinebaug River, Connecticut, is studied using energy analysis. The analysis considers the effects of alternative minimum flow releases, ranging from 0 to 34 cubic meters per second (cms), on the total energy flow of the affected system. The principal system components affected by differing minimum flows are hydroelectric power generation, aquatic habitat, and gross aquatic ecosystem productivity. The minimum flow alternative resulting in the highest annual energy flow in the affected system is considered optimal. From this purely analytical point of view, the optimum minimum flow is 0 cms, due to the short length and low productivity of the regulated reach, and the lack of floodplain interactions. Simulations of longer and more productive river reaches were conducted. For very short, unproductive reaches, in the absence of a floodplain, the contribution of aquatic community productivity to total system energy flow is negligible compared to hydroelectric generation. Optimum minimum flows are higher for longer and more productive reaches. For such cases the operation of hydroelectric dams could reduce total system energy flow because the energy supplied by hydroelectric generation may be offset by losses in aquatic productivity due to diminished riverine habitat. (Author's abstract)
W85-02297

FLOOD PROTECTION IN THE LOIRE VALLEY DOWNSTREAM VIENNE CONFLUENCE (PROTECTION DES VALS DE LOIRE EN AVAL DE LA CONFLUENCE AVEC LA VIENNE),
Montpellier-2 Univ. (France). Lab. d'Hydrologie Mathematique.
A. Guilbot, J.-C. Hemain, P. Raous, G. Tessier, and J.-P. Kryn.
Houille Blanche, No. 1/2, p 121-132, 1984. 14 Fig, 7 Ref.

Descriptors: *Flood control, *River basins, *Frequency analysis, *Loire Valley, *France, Statistical analysis, Model studies, Dam construction, Planning, Decision making.

In order to respond to political and economic authorities who were concerned about a possible coincidence of extremely high floodwater on the Loire with very high water levels on the Vienne or the Maine Rivers, a study of floodwater stages on the Loire and its tributaries was performed. The effectiveness of a flood regulating reservoir on the Vienne downstream from its confluence with Creuse was examined along with a study of the risks of levees being submerged by Loire flood waters. Methods used for these studies ranged from descriptive to statistical hydrology for model design. Based on the findings which revealed no series of extraordinary events leading to coincidence of floods coupled with the fact that construction would be difficult, the decision was made to reinforce the levees as opposed to constructing a dam on the Vienne. (Baker-IVI)
W85-02355

STOCHASTIC OPTIMIZATION MODEL FOR REAL-TIME OPERATION OF RESERVOIRS USING UNCERTAIN FORECASTS,
Washington Univ., Seattle. Dept. of Civil Engineering.
B. Datta, and M. H. Houck.
Water Resources Research, Vol. 20, No. 8, p 1039-1046, August, 1984. 3 Fig, 3 Tab, 23 Ref. NSF grant CME-7916819 and Purdue Research Foundation grant XR-0340.

Descriptors: *Reservoir operation, *Model studies, Forecasting, Decision making, Reservoir releases, Reservoir storage, Flow control.

For real time operation of reservoirs, where decisions are made relatively quickly and are based on short-term information, decisions regarding release should be dependent on the starting reservoir storage, penalties for deviations from planned targets, and short-term forcasts. A real-time operation model was developed based on a chance constraint formulation assuming a particular form of the linear decision rule. It uses the conditional distribution function (CDF) of actual streamflows conditioned on the forecasted values. These CDF'S are constructed by incorporating the statistical properties of forecast errors for different time steps. The objective for development of the model was minimization of weighted probable deviations from storage and release targets for operations over a time horizon of several days to a month. These weights are surrogates for the actual loss functions, and the probable deviations are functions of the reliability levels specified in the model. With the use of target values for release and storage, this model is capable of using a release policy that is a subset of a seasonal policy and overcomes the myopic (short-sighted) nature of operation. Simulation of actual operation, using this model for a hypothetical reservoir, demonstrated the feasibility and efficiency of this approach. This model is applicable for a system of reservoirs while remaining within the range of computational feasability. The restrictions associated with the use of a linear decision rule are invalid for this model. The model should be solved at the beginning of each day, with updated forecasts, revised conditional distribution functions of future streamflows, and the state of the system given by the initial storage used as inputs. (Collier-IVI)
W85-02360

IMPACT OF ZOOPLANKTON STATUS ON THE MANAGEMENT OF LAKE KINNERET (ISRAEL),
Kinneret Limnological Lab., Tiberias (Israel).
For primary bibliographic entry see Field 2H.
W85-02410

OXYGEN CONSUMPTION BY THE CRAYFISH ORCONECTES PROPINQUUS (GIRARD) EXPOSED TO AQUASHADE,
Indiana Univ.-Purdue Univ. at Indianapolis. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W85-02420

MANIPULATION OF THE PELAGIC FOOD WEB BY STOCKING WITH PREDACIOUS FISHES,
Technische Univ., Dresden (German D.R.). Bereich Hydrobiologie.
J. Benndorf, H. Kneschke, K. Kossatz, and E. Penz.
Internationale Revue der Gesamten Hydrobiologie, Vol. 69, No. 3, p 407-428, 1984. 7 Fig, 5 Tab, 60 Ref.

Descriptors: *Water quality control, *Lakes, *Fish, *Predators, *Nutrients, Population dynamics, Eutrophication, Zooplankton, Crustacea, Food chain.

After studying the original status in a small mesotrophic pond in a former quarry for two years, the pond was densely stocked with predacious fishes in the spring of 1981. The response of the ecosystem to this intervention was observed up to the end of 1981. The virtual elimination of the small fishes feeding on zooplankton by stocking the pond with predacious fishes leads, even in the presence of a very efficient predacious invertebrate, Chaoborus flavicans, to a major reduction of mortality among the herbivorous zooplankton. During the second half of the summer and during autumn, the mean body weight of the crustacean increased rapidly in 1981, which was not observed in the water in its original state. This was due to the almost complete disappearance of the small crustaceans, and the dominance of larger species. The Chaoborous larvae, due to their diurnal migration, their preference for moderately sized prey and their life cycle, cannot exert the same grazing pressure as the small fishes. The mean and maximum crustacean biomass and the mean individual body weight of the crustaceans were very much higher in 1981 than in the years with a very large stock of small fishes. If phytoplankton growth is definitely limited by nutrients, biomanipulation of the kind described here has only a very slight effect on the mean and maximum summer phytoplankton biomass. But even when nutrient limitation is marked, this form of biomanipulation induces a distinct change in the species composition of the phytoplankton. Due to this change, the Secchi depth increases although the phytoplankton biomass remains the same. When using biomanipulation as a means of water quality management, it is obviously necessary to take into account internal ecological control mechanisms that are much too complicated to be expressed as simple schemes. (Baker-IVI)
W85-02565

MANAGING WATER RESOURCES IN THE NEW ORLEANS AREA,
Environmental Professionals, Metairie, LA.
H. Miller, and E. Silberhorn.
Journal of the Water Pollution Control Federation, Vol. 56, No. 9, p 995-1002, September, 1984. 6 Fig, 1 Tab, 14 Ref.

Descriptors: *New Orleans, *Louisiana, *Water resources development, *Management, Decision making, Mississippi River, Lake Pontchartrain, Flood control.

New Orleans' dependence on water for shipping, fishery resources, and drinking water has led to numerous management and control programs for water resources in the area. Some of the most promising issues facing local residents includes flood control and water quality of the Mississippi River, factors affecting the Lake Pontchartrain basin, loss of wetlands, and erosion of the Louisiana coastline. Flood control on the Mississippi includes flow diversion projects, along with levees, channel, and tributary basin improvements. Problems solved concerning Lake Pontchartrain included bacterial pollution, wetlands loss, and dredging of the lake. (Baker-IVI)
W85-02581

SHORT-TERM, SINGLE, MULTIPLE-PURPOSE RESERVOIR OPERATION: IMPORTANCE OF LOSS FUNCTIONS AND FORECAST ERRORS,
Washington Univ., Seattle. Dept. of Civil Engineering.
B. Datta, and S. J. Burges.
Water Resources Research, Vol. 20, No. 9, p 1167-1176, September, 1984. 10 Fig, 19 Ref.

Descriptors: *Reservoir operation, *Forecasting, *Loss functions, *Multipurpose reservoirs, Optimization, Reservoir releases, Reservoir storage, Model studies, Streamflow.

Short-term operation policy for multipurpose reservoirs can be derived from an optimization model with the objective of minimizing short-term losses (opportunity costs). Construction of such loss functions requires the definition of target values for the decision variables, assessment of reliabilities with which inflows can be predicted, and an explicit statement of operational objectives. Formulation and evalution of a model is complicated by the uncertainties inherent in the prediction of future streamflows and by controversies about the criteria of evaluation. A series of synthetic short-term forecasted values (which satisfy a specified distribution of forecast errors) is used to examine operation of a single reservoir. The quality of forecasted values is represented by the mean and variance of these errors or the coefficient of prediction (Cp). The objective function of the operation model is assumed to be the best possible tradeoff between probable deviations from two operation targets: release and storage volume. Reservoir release was effected according to the solution of the optimization model conditioned upon the forecasted streamflow volumes for a given time increment. The storage volume was then corrected to reflect actual streamflow for the forecasted period. This became the initial storage for the next forecast period. Actual losses, deviations between actual and forecasted losses, the variance of storage and release volumes, and operational performance measures, including reliability, resiliency, and vulnerability, were sensitive to the relative importance given to deviations from release or storage targets and the quality of forecasts. The performance of an operation policy based on a model that uses predicted streamflow as deterministic inputs cannot be correlated directly with the shape of the assumed loss function. (Author's abstract)
W85-02658

MONTE CARLO OPTIMIZATION FOR RESERVOIR OPERATION,
Humboldt State Univ., Arcata, CA. Dept. of Environmental Resources Engineering.
R. Willis, B. A. Finney, and W.-S. Chu.
Water Resources Research, Vol. 20, No. 9, p 1177-1182, September, 1984. 6 Fig, 2 Tab, 13 Ref.

Descriptors: *Reservoir operation, *Optimization, *Monte Carlo method, *Mad River Basin, *California, Reservoir releases, Reservoir storage, Streamflow, Model studies.

The probability distribution function for the optimal reservoir release, which is conditioned on the state and input variables of the reservoir system, is developed using a Monte Carlo optimization approach. The optimal release for each time period in the operational horizon is determined by using linear programming. After repeating this procedure for a large number of synthetic streamflow sequences, an operational release policy is determined by utilizing the probability mass function of the optimal releases, conditioned on observable hydrologic conditions. The methodology is applied to the Mad River Basin in northern California to develop monthly reservoir release policies that use reservoir storage and inflow as the observed conditioning hydrologic variables. The Monte Carlo optimization methodology is a practical tool for developing reservoir release policies. Although a series of large linear models are solved initially, the computational requirements do not exceed the resources needed by currently available real-time operational models. The release policies developed from the Monte Carlo optimization methodology can provide target storages for real-time models. (Moore-IVI)
W85-02659

4B. Groundwater Management

GROUNDWATER AND INTERGOVERNMENTAL RELATIONS IN THE SOUTHERN SAN JOAQUIN VALLEY OF CALIFORNIA: WHAT ARE ALL THESE COOKS DOING TO THE BROTH,
B. T. Andrews, and S. K. Fairfax.
University of Colorado Law Review, Vol. 55, No. 2, p 145-271, Winter, 1984, 2 Fig, 1 Tab, 701 Ref.

Descriptors: *Groundwater management, *Legal aspects, *California, *San Joaquin Valley, History, Planning, Federal jurisdiction, State jurisdiction.

An institutional analysis of groundwater use in California's southern San Joaquin Valley is presented. The often intricate interactions between the local, state and federal factors responsible for groundwater management in the Valley are highlighted. Commonly held perceptions about the interrelationship between surface and groundwater policies, Valley attitudes toward groundwater use and the growing state wide desire for greater state and federal involvement in the regulation of groundwater in the southern San Joaquin Valley are reassessed. The approach taken in this study differs in four major ways from that found in most of the literature regarding the management of groundwater resources. First, the inquiry treats groundwater as just one aspect of overall water resource management, rather than as a separate entity. Secondly, the inquiry suggests that the virtues of local management relating to Valley groundwater use merit wider recognition and public discussion. Thirdly, the crucial role of imported surface water in local groundwater management is examined with underscoring of the prominence of the state and federal water supply agencies in the southern San Joaquin Valley. Fourthly, the research stresses not the need for new authorities and programs, but the importance of considerable unexercised authorities at the local, state and federal levels of government. (Baker-IVI)
W85-02184

OPTIMIZING PUMPING STRATEGIES FOR CONTAMINANT STUDIES AND REMEDIAL ACTIONS,
Robert S. Kerr Environmental Research Lab., Ada, OK.
For primary bibliographic entry see Field 5G.
W85-02217

CALCULATION OF COMPLETE INTERCEPTION OF GROUNDWATER INFLOW TO 'PERFECT' TRENCHES BY LIGHT WELLPOINT INSTALLATIONS,
V. M. Grigorev.
Hydrotechnical Construction, Vol. 17, p 618-626, December, 1983. 5 Fig, 3 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 12, p 21-25, December, 1983.

Descriptors: *Intercepting ditches, *Mathematical equations, *Draining engineering, Draining, Permeability, Soil properties, Groundwater, Wellpoints.

It is considered that under real conditions at construction sites complete interception by light wellpoint vacuum groundwater lowering installations can be successfully accomplished only when draining fine-grained soils with a permeability coefficient equal to 0.05-2 m/day, with the artificial creation of considerable negative heads in the receiving links of the wellpoints in the initial period of operation of the installation with the use of wellpoints with a high sand filling around them or well points with air pipes. The simplest method, not requiring a modification of the standard design of the wellpoints, is the placement of a high sand filling around them. This variant of organization of complete interception of water is examined. A comprehensive calculation of complete interception can be performed by the method given determining the order of performing the calculation operations. (Baker-IVI)
W85-02229

METHOD FOR OPTIMAL OBSERVATION NETWORK DESIGN FOR GROUNDWATER MANAGEMENT,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
J. Carrera, E. Usunoff, and F. Szidarovszky.
Journal of Hydrology, Vol. 73, No. 1/2, p 147-163, July, 1984. 5 Fig, 1 Tab, 23 Ref. US - Spain Joint Committee for Scientific and Technological Cooperation grant T3770171.

Descriptors: *Network design, *Kriging, *Groundwater management, Decision making, Planning, Soil properties, Fluoride, Water quality, Hydrology.

A method for selecting optimal locations from a discrete set of possible measurement points is based on nonlinear programming and a special branch and bound technique. It is simple and data requirements are small. The method is applied to the optimal location of measurement points in the San Pedro River basin, Arizona, to estimate the fluoride concentration of the groundwater. While the measurement point location procedure can be applied successfully in hydrology, further applications may include heads and/or transmissivity estimation, water quality, and soil properties. If drift is present, a number of specific methods can be used to estimate the variogram, such as universal kriging, or iterative processes. The methodology described can be extended into a multiobjective framework by using cokriging, if the functions are correlated, or by a simple extension of the proposed methodology. In general, the results in terms of optimal configuration, are expected to be insensitive to small variations of the kriging parameters. If that is not the case, their uncertainty can be handled by using Bayesian decision theory. (Baker-IVI)
W85-02463

SIMPLIFIED GRAPHICAL SOLUTION OF THE THEIS EQUATION,
Victoria State Rivers and Water Supply Commission, Tatura (Australia).
W. T. Griffiths, and D. Ife.
Journal of Hydrology, Vol. 73, No. 1/2, p 177-186, July, 1984. 7 Fig, 4 Ref.

Descriptors: *Aquifer characteristics, *Pumping tests, *Theis equation, Transmissivity, Storage coefficient, Specific yield, Drawdown.

The Theis type curve solution has been graphicaly extended to permit analysis of pumping test results without numerical calculation. The graphical technique proposed enables various analyses of pumping test data to be carried out in the field as tests proceed. It should also lead to a better understanding of the inter relationship between variables in the mathematically complex Theis equation. The method employs a transparent overlay which permits direct reading of transmissivity and storage coefficient for any set of time-drawdown readings.

Distance-drawdown readings can also be analyzed in the same way, and the overlay can be used to determine the time-drawdown curve for a known set of aquifer parameters. A single time-drawdown point can produce one aquifer characteristic if an assumption of the other characteristic is made. The costs involved in the preparation of the special data sheet and overlay would be offset by the benefits and versatility provided by this technique, as this method will assist in understanding the ways in which the various parameters of the Theis equation interrelate and as such can be used in the design and interpetation of aquifer tests. (Baker-IVI)
W85-02465

STRESSES AND DISPLACEMENTS IN AN AQUIFER DUE TO SEEPAGE FORCES (ONE-DIMENSIONAL CASE),
Universidad Nacional Autonoma de Mexico, Mexico City. Facultad de Ingenieria.
For primary bibliographic entry see Field 2F.
W85-02489

INFLUENCE OF SEEPAGE ON THE DEPTH OF WATER TABLES IN DRAINAGE,
Instituut voor Cultuurtechniek en Waterhuishouding, Wageningen (Netherlands).
J. G. Wesseling, and J. Wesseling.
Journal of Hydrology, Vol. 73, No. 3/4, p 289-297, August, 1984. 4 Fig, 2 Tab, 4 Ref.

Descriptors: *Drainage, *Water tables, *Seepage, *Groundwater flow, Aquifers, Subsoil drainage.

A theory has been developed that describes the depth of the water table in the case of a soil underlain by an artesian aquifer which is drained by means of a subsoil drainage system. The theory is based on two-dimensional groundwater flow and solutions were obtained for both steady- and non-steady-state conditions. The problem under discussion consists of an aquifer with a layer of sand covered by a layer of less permeable peat or clay in which the drains are situated. Drain level is taken as zero-level, and therefore the piezometric head of the groundwater in the aquifer itself, designated by H, is considered to be constant. Since H is larger than the piezometric level of the phreatic water in the covering layer (h), an upward vertical flow of seepage water takes place. Near the drains the largest difference in heads exists and hence the largest seepage flow will take place there. This implies that the seepage and hence the feeding of the drains is not uniformly distributed over the surface as is generally the case with rainfall. (Bkaer-IVI)
W85-02490

FLOW TOWARD STORAGE TUNNELS BENEATH A WATER TABLE; 2. THREE-DIMENSIONAL FLOW,
Tel-Aviv Univ. (Israel). Faculty of Engineering.
A. Tal, and G. Dagan.
Water Resources Research, Vol. 20, No. 9, p 1216-1224, September, 1984. 10 Fig, 13 Ref.

Descriptors: *Groundwater movement, *Recharge wells, *Artifical recharge, Water table, Mathematical models, Oil storage, Gas storage, Underground storage, Well spacing.

In a system of galleries for storage of oil products or liquefied gas which are excavated in saturated rock beneath a water table, the natural recharge has to be supplemented by an artifical one. By adjusting the recharge, a steady state can be achieved with the free surface kept in a fixed position and the total recharge equal to the discharge into galleries. The water table is prevented from descending and is maintained in a steady position by a battery of recharging wells. The three-dimensional flow problem is solved first by a simplified linearization approximation which is valid for flat water table which is sufficiently high above the gallery. The full nonlinear free surface problem is subsequently solved numerically by the boundary integral element method, and the range of validity of the linearized approximation is established. The solution provides the tools needed in order to design an optimal well system (spacing, length, discharge) for given gallery setup, product pressure, and water table height. A comparison between the approximate and numerical solutions for a few configurations suggests that the first is quite accurate if the free surface average slope above the cavern roof is smaller than 10%. For larger slopes the well spacing is determined by the approximate solution in a conservative manner, the use of the numerical scheme is recommended. (Moore-IVI)
W85-02663

FIELD TESTING THE HYPOTHESIS OF DARCIAN FLOW THROUGH A CARBONATE AQUIFER,
Geological Survey, Tampa, FL.
J. J. Hickey.
Ground Water, Vol. 22, No. 5, p 544-547, September-October, 1984. 4 Fig, 8 Ref.

Descriptors: *Groundwater movement, *Carbonate aquifers, *Darcian flow, *Pinellas County, *Florida, Drawdown, Transmissivity, Storage coefficient, Pumping tests, Leakance.

The acceptability of the hypothesis of Darcian flow through a semiconfined carbonate aquifer was tested prior to running a multiple-day aquifer test in Pinellas County, Florida. The approach used to test the hypothesis was to run a number of hour-long aquifer tests at different discharges with drawdown measured at the same time during each test in two observation wells, one at 35 feet and the other at 733 feet from the pumped well. If the hypothesis were acceptable, a plot of drawdown versus discharge should describe a straight line. A linear relation was described in 15-minute and 1-hour data plots of drawdown versus discharge for both observation wells. Thus, the hypothesis of Darcian flow through the semiconfined carbonate aquifer was deemed acceptable. Drawdown data from the distant observation well collected during the following multiple-day aquifer test were then analyzed for aquifer-property values of transmissivity, storage coefficient, and leakance coefficient using standard methods. Discharge for the multiple-day test was within the discharge range of the hour-long tests. (Author's abstract)
W85-02686

OPTIMAL SPACING OF INTERFERING WELLS: AN ANALYTIC SOLUTION,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
J. Briscoe.
Ground Water, Vol. 22, No. 5, p 573-578, September-October, 1984. 5 Fig, 10 Ref, 1 Append.

Descriptors: *Well spacing, *Interfering wells, Optimization, Well fields, Costs, Pipelines, Transmissivity, Pumping.

The optimal spacing of pumped wells in a well field involves a trade-off between pumping costs (which increase as well spacing is reduced and interference increases) and the costs of connecting pipelines (which decrease as well spacing is reduced). An expression is derived analytically for the optimal spacing between wells in a rectangular field in an ideal, confined aquifer. A simple, practical method for determining the optimal spacing is presented. The optimal spacing is substantially different from the spacing determined by use of the Theis formulation. The economic savings resulting from use of the revised approach are considerable, especially when the number of wells is large and the transmissivity of the aquifer low. (Moore-IVI)
W85-02690

NUMERICAL METHOD OF PUMPING TEST ANALYSIS USING MICROCOMPUTERS,
Birmingham Univ. (England). Dept. of Civil Engineering.
K. S. Rathod, and K. R. Rushton.
Ground Water, Vol. 22, No. 5, p 602-608, September-October, 1984. 3 Fig, 4 Tab, 7 Ref.

Descriptors: *Computer models, *Pumping tests, Mathematical models, Computers, Aquifers.

A numerical method of pumping test analysis, which has proved to be useful in many practical situations, can be run on microcomputers. The basis of the numerical approach is to solve the time-variant differential equation using a finite difference approach in which the radial dimension is divided into discrete intervals which increase logarithmically from small values near the well to large values towards the boundary. The time dimension is also divided into discrete steps which increase logarithmically. Full details of a version of the numerical model program in BASIC and a test problem are provided. It is essential to check the program thoroughly since the accuracy of computation varies for different microcomputer systems. The use of this numerical model is both for the analysis of pumping tests which are difficult to interpret using conventional methods, and for the prediction of the likely response due to extensive pumping from an aquifer. (Moore-IVI)
W85-02694

SIMPLE ANALYTICAL SOLUTIONS FOR THE HP41CV PROGRAMMABLE CALCULATOR,
Kleinfelder (J.H.) and Associates, Fresno, CA.
S. J. Baker.
Ground Water, Vol. 22, No. 5, p 609-616, September-October, 1984. 3 Fig, 1 Tab, 6 Ref, 3 Append.

Descriptors: *Computer models, *Pumping tests, *Aquifers, Drawdown, Mathematical models.

Two useful programs have been developed for the Hewlett Packard HP41CV programmable calculator. The THEIS program is designed to simulate a well pumping from a confined or unconfined aquifer. Drawdown, residual drawdown, t/t sub 1 and t/r sq are calculated. The BOUN program is designed to solve for drawdown in a well pumping from an aquifer bounded by two parallel impermeable barriers. The programs can be used in aquifer pumping test design, pumping test analysis, and aquifer response predictions. (Author's abstract)
W85-02695

4C. Effects On Water Of Man's Non-Water Activities

BETTER RATIONALE FOR WETLAND MANAGEMENT,
Nelson (R. Wayne) and Associates, Inc., Boulder, CO.
For primary bibliographic entry see Field 2L.
W85-02295

RECREATIONAL IMPACTS ON COLORADO RIVER BEACHES IN GLEN CANYON, ARIZONA,
Museum of Northern Arizona, Inc., Flagstaff. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W85-02298

ALTERATION OF STREAMFLOW CHARACTERISTICS FOLLOWING ROAD CONSTRUCTION IN NORTH CENTRAL IDAHO,
Intermountain Forest and Reange Experiment Station, Moscow, ID. Forestry Sciences Lab.
For primary bibliographic entry see Field 2E.
W85-02372

INFLUENCE OF FORESTRY DRAINING ON RUNOFF AND SEDIMENT DISCHARGE IN THE YLIJOKI BASIN, NORTH FINLAND,
National Board of Waters, Helsinki (Finland).
P. Seuna.
Aqua Fennica, Vol. 12, p 3-16, 1982. 14 Fig, 5 Tab, 17 Ref.

Descriptors: *Drainage effects, *Runoff, *Sediment transport, *Forest managment, *Ylijoki basin, *Finland, Suspended solids, Seasonal variation, Floods, Melting.

The effects on runoff and on the transport of suspended solids caused by forestry draining in the

Ylijoki basin, northern Finland are discussed. The control basin method was used. The drainages were performed mainly in 1979 and the total area drained amounted to 17% of the Ylijoki basin. Additionally a small amount of forestry plowing was carried out, the effects of which are included in the following changes. Peat soils comprise about 60% of the catchments; dominating mineral soils are coarse sand and coarse sand moraine. During the two first years after the drainage, runoff changes were approximately as follows: for mean annual + 10%, for spring maximum - 10%, for summer maximum + 35% and for winter and summer mimima + 50%. The annual transport of suspended solids increased 6.16 t/sq km in 1980 and 10.48 t/sq km in 1981. Both increases were more than four times the computed 'undrained' yield and statistically significant (risk < 0.1%). Of the total annual yield 91% came during spring flood, while the respective figure before draining was about 65%. The concentration of suspended solids became very dependent on runoff, which was not the case before draining. In a separate ditching plot, Kettumaa, the discharge of suspended solids was as much as 230 t/sq km during the first spring flood after draining. The highest concentration occurred during the rise of flood (> 1500 mg/l) and right after the melt of soil frost (> 2000 mg/l), in spring of 1980 following the drainage. The same procedure occurred in the next spring although on a much lower level. (Author's abstract)
W85-02384

SIMULATION OF GROUND-WATER FLOW IN A MINED WATERSHED IN EASTERN OHIO,
Geological Survey, Columbus, OH.
J. S. Weiss, and A. C. Razem.
Ground Water, Vol. 22, No. 5, p 549-560, September-October, 1984. 18 Fig, 11 Ref.

Descriptors: *Groundwater movement, *Coal mining, *Simulation, *Ohio, *Muskingum County, Strip mines, Groundwater recharge, Permeability coefficient, Geohydrology, Surface-groundwater relations, Leakage, Hydraulic head.

A 43-acre watershed in Muskingum County, Ohio, was studied to determine the hydrologic consequences of strip mining for coal. A quantitative description of the effects on the ground-water flow components of the hydrologic system has been obtained using digital models. The premining watershed was characterized by nearly flat-lying sedimentary rocks of the Pennsylvanian System. Underclay beneath the two major coal beds formed bases for perched zones, creating three separate aquifers. Recharge to the ground-water system occurred mainly by percolation of precipitation. Most of the discharge from the top and middle aquifers occurred by downward leakage to the underlying aquifers. A smaller amount of discharge occurred as springflow or streamflow near the intersections of the underclays and land surface. Mining has destroyed the top aquifer, and has replaced the bedrock by spoil material. Water levels in the spoils are at a much lower altitude than existed in the premining top aquifer because of a combination of (1) a larger hydraulic conductivity, (2) areal variations of the hydraulic characteristics of the confining bed, and (3) a slower rate of recharge from precipitation caused by removal exposed portions of the middle aquifer and a lower hydraulic head in the spoils has allowed less recharge to the middle aquifer. Additional flow is induced across the western boundary of the watershed and has reduced the outflow across the eastern boundary. Discharge from the middle aquifer as downward leakage and streamflow is less than before mining. (Author's abstract)
W85-02687

4D. Watershed Protection

RUNOFF AND EROSION RESPONSE OF RECLAIMED SURFACES,
Agricultural Research Service, Fort Collins, CO.
D. M. Hartley.
Journal of Hydraulic Engineering, Vol. 110, No. 9, p 1181-1199, September, 1984. 4 Fig, 10 Tab, 17 Ref.

Descriptors: *Land reclamation, *Erosion control, *Runoff, *Model studies, Rainfall, Precipitation, Soil loss, Computers, Strip mines, Land reclamation, Soil control.

A method for characterizing the runoff and erosion behavior of reclaimed surfaces is described and demonstrated using data from a surface coal mine. The method used data from simulated rainfall field tests to calibrate or estimate parameters in a long term soil water balance model and a single event water and sediment routing model. Distributed parameter model simulations provide realistic comparisons of reclamation options because they explicitly treat local precipitation characteristics and represent the responses of different treatments based on their respective infiltration, hydraulic, and soil erodibility characteristics. After parameter values have been estimated, soil loss and runoff comparisons for a range of precipitation and topographic conditions are easily obtained. A simulation of the responses of four different surface treatments to five different first years of historical precipitation from the study area indicates substantial differences between the treatments. Predicted soil losses are low for all treatments at moderate topographic conditions. At more extreme topographic conditions, these differences appear to take on greater significance. The simulation study demonstrates the dominance of infrequent, intense precipitation events in causing the bulk of soil losses. This points out the need to establish treatment features such as mulching rates, contour furrows and surface gradients based on design storms of a given frequency rather than average annual events. The simulation technique illustrated can be used to make comparisons of alternative treatments. (Baker-IVI)
W85-02449

STREAM ECOSYSTEMS IN MOUNTAIN GRASSLAND (WEST CARPATHIANS); 1. INTRODUCTION AND DESCRIPTION OF THE INVESTIGATED AREA,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
For primary bibliographic entry see Field 6G.
W85-02512

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

INTRASPECIFIC VARIATION IN COPPER SUSCEPTIBILITY OF THE BLUEGILL SUNFISH,
Maryland Univ., Solomons. Chesapeake Biological Lab.
For primary bibliographic entry see Field 5C.
W85-02194

MULTIPLE BIOASSAYS TO ASSESS THE TOXICITY OF A SANITARY LANDFILL LEACHATE,
Massachusetts Univ., Amherst. Dept. of Civil Engineering.
S. Plotkin, and N. M. Ram.
Archives of Environmental Contamination and Toxicology, Vol. 13, No. 2, p 197-206, March, 1984. 3 Fig, 9 Tab, 36 Ref.

Descriptors: *Landfills, *Leachates, *Toxicity, *Bioassay, *Fitchburg, *Massachusetts, Fathead minnows, Daphnia, Chlorophyta, Bacteria, Algal growth, Water pollution effects.

Fitchburg, Massachusetts sanitary land-fill leachate was subjected to toxicity tests using: fathead minnows (Pimephales promelas), zooplankton (Daphnia magna), green algae (Selenastrum capricornutum) and aerobic luminescent bacteria (Photobacterium phosphorium). The leachate was highly toxic to the test bacteria, moderately toxic to daphnids, and slightly toxic to fathead minnows. Algal cells, unable to grow at 10% leachate exposure level, recovered after centrifugation and reinnoculation into algal nutrient medium. Low-flow summer hydrological data indicated that the leachate contributed about 7% to the total flow of the receiving stream, Flagg Brook, and about 0.6% to Sawmill Pond water located further downstream from the leachate outfall. These data, together with observed toxicity values for the test organisms, indicate that the leachate concentration in Flagg Brook impacts the diversity of aquatic life in this system, but may be less severe in Sawmill Pond where increased dilution results in leachate levels below the acutely toxic level. The considerable variation between toxicity test results obtained with the four test organisms, demonstrates the importance of conducting several such toxicity tests using organisms from different trophic levels, to assess the potential impact of a pollutant discharge on an aquatic ecosystem. (Author's abstract)
W85-02202

DETERMINATION OF PICLORAM IN SOIL AND WATER BY REVERSED-PHASE LIQUID CHROMATOGRAPHY,
Auburn Univ., AL. George W. Andrews Forestry Science Lab.
M. J. M. Wells, J. L. Michael, and D. G. Neary.
Archives of Environmental Contamination and Toxicology, Vol. 13, No. 2, p 231-235, March, 1984. 3 Fig, 1 Tab, 20 Ref.

Descriptors: *Picloram, *Pollutant identification, *Liquid chromatography, Herbicides, Pesticide residues, Soil contamination.

The environmental impact downstream from the treatment of forested areas with the herbicide picloram is of concern because of the solubility of the potassium salt of picloram and the slow degradation by soil microorganisms. A reverse-phase liquid chromatographic method is presented for the determination of picloram in the parts per billion (ppb) range in soil, soil solution, and stream samples. Quantification is effected by UV absorption at 254 nm. The method permits 92% +/- 7.1 recovery from water samples and 61.8% +/- 11.1 recovery from soil samples. Derivatization of picloram by diazomethane is avoided because the compound is detected by UV absorbance as the underivatized free acid. (Moore-IVI)
W85-02204

NICKEL UPTAKE AND LOSS IN THE BIVALVES CRASSOSTREA VIRGINICA AND MYTILUS EDULIS,
Environmental Research Lab., Narragansett, RI.
G. E. Zaroogian, and M. Johnson.
Archives of Environmental Contamination and Toxicology, Vol. 13, No. 4, p 411-418, July, 1984. 5 Fig, 29 Ref.

Descriptors: *Bioindicators, *Nickel, *Oysters, *Mussels, Heavy metals, Seawater, Water pollution.

Nickel uptake and loss by Crassostrea virginica and Mytilus edulis were studied at naturally occurring seawater temperatures and salinity to determine their potential as indicators of nickel pollution. After 12 wks treatment with 5 and 10 micro g Ni/kg seawater, mean tissue concentrations in C. virginica were 9.62 +/- 3.56 and 12.96 +/- 5.15 micro g/g dry weight. Mean nickel concentrations in M. edulis treated with 5 and 10 micro g Ni/kg seawater for 12 wks were 10.40 +/- 2.66 and 16.43 +/- 3.19 micro g/g dry weight, respectively. Significant linear relationships were found between nickel uptake by C. virginica and M. edulis and seawater nickel concentrations over the concentration range. A significant inverse relationship exists between tissue nickel concentration and dry weight in both C. virginica and M. edulis. After holding nickel-treated M. edulis in ambient flowing seawater for 28 weeks, a 73 and 89% loss of nickel concentration occurred in M. edulis treated with 5 and 10 micro g Ni/kg, respectively. When treated similarly, C. virginica from both the 5 and 10 micro g Ni/kg treatments lost 48 and 68% respectively, of their tissue nickel concentration. The evidence suggests that M. edulis would be a better

indicator of nickel pollution in its environment than C. virginica. (Author's abstract)
W85-02212

APPLICABILITY OF SOME NUMERICAL METHODS AND THE EVALUATION OF BRYOPHYTA INDICATOR SPECIES FOR THE COMPARISON OF THE DEGREE OF POLLUTION BETWEEN TWO RIVERS,
Ljubljana Univ. (Yugoslavia). Biological Inst.
D. Vrhovsek, A. Martincic, and M. Kralj.
Archiv fur Hydrobiologie, Vol. 100, No. 4, p 431-444, July, 1984. 5 Fig, 2 Tab, 16 Ref.

Descriptors: *Water quality, *Water pollution detection, *Bioindicators, *Bryophytes, *Yugoslavia, Sora River, Savinja River.

The possibility of establishing a qualitative and quantitative comparison of bryophyte indicator species and numerical methods for evaluating a degree of pollution in geographically distant rivers was investigated. The rivers Sora and Savinja are tributaries of the main Solvenian River, Sava. Both rivers have a prealpine character and only the upper part of Savinja is more alpine. The hydrographic character of the lower parts of both rivers is very similar. The geographical basis of both rivers is formed from triadic calcereous rocks and dolomite. In the Sora, pollution is mainly organic, while in the lower part of the Savinja, especially from the city Celje, pollution is also inorganic. The degree of pollution in the rivers could be adequately determined from the presence of indicator species, Jaccard's coefficient of similarity and Newbould's coefficient of difference. The application of joint species frequency and coefficient of development were not satisfactory due to small qualitative and quantitative differences in species composition between sampling points. (Baker-IVI)
W85-02238

STATISTICAL PROCEDURES FOR APPLYING HILSENHOFF'S BIOTIC INDEX,
Wisconsin Dept. of Natural Resources, Madison. Water Quality Evaluation Section.
R. P. Narf, E. L. Lange, and R. C. Wildman.
Journal of Freshwater Ecology, Vol. 2, No. 5, p 441-448, August, 1984. 2 Fig, 1 Tab, 10 Ref.

Descriptors: *Water quality, *Measuring instruments, *Streams, Hilsenhoff's Biotic Index, Wisconsin, Evaluation, Statistical methods.

The water quality of Wisconsin streams was evaluated using Hilsenhoff's biotic index (HBI). The variability of the HBI must be known or estimated in order to detect significant differences in water quality. Based on this study, the best estimate of the HBI standard deviation in fall samples is 0.197. From the standard deviation and variance estimate two statistical procedures are presented that test for significant differences between paired HBI values - the detectable difference method for equal sample sizes and the t-test for unequal sample sizes. The detectable difference method provides a means for determining the statistical difference between two index values derived from an equal number of samples collected from different streams, different locations on the same stream, or the same stream location sampled in the fall season of different years. (Baker-IVI)
W85-02245

WATER QUALITY ASSESSMENT OF SEVEN RIVERS IN NOTO PENINSULA USING EPILITHIC DIATOM COMMUNITIES ON RIVER BED AS BIOLOGICAL INDICATORS (IN JAPANESE),
Meiho High School, Kanazawa City (Japan).
M. Sumita, and T. Watanabe.
Japanese Journal of Limnology, Vol. 45, No. 2, p 134-143, April, 1984. 2 Fig, 7 Tab, 7 Ref.

Descriptors: *Japan, *Noto Peninsula, *Wakayama-gawa River, *Machino-gawa River, *Kawarada-gawa River, *Fugeshi-gawa River, *Yamada-gawa River, *Togi-gawa River, *Misogigawa River, *Pollution index, *Diatoms, Water quality, Water pollution, Species composition, Ecological effects.

A previously developed equation for determining a river pollution index (RPI sub B) used water quality chart data acquired through the traditional method of water quality estimation by indicator organisms. The value of RPI sub B obtained from such a water quality chart was somewhat ambiguous for estimation of the degree of pollution, because the traditional water quality chart indicates the distribution of an area with only four to six different degrees of water pollution. However, the degree of water pollution in the river actually changes gradually and continuously and they can not thus be divided numerically into definite classes by degrees. A previously reported new approach to the general estimation of river pollution that uses a new diatom community index (NDCI) was used for determining river pollution indices (RPI sub D) in seven rivers in the Noto Peninsula of Ishikawa Prefecture. The rivers surveyed and their respective RPI sub D values were: R. Wakayama-gawa, 60; R. Machino-gawa, 82; R. Kawarada-gawa, 66; R. Fugeshi-gawa, 58; R. Yamada-gawa, 63; R. Togi-gawa, 54; R. Misogigawa, 33. The water quality of the rivers was worse than expected and the degree of water pollution approximated those of rivers polluted by waste water. (Collier-IVI)
W85-02255

ASSAY FOR BIOLOGICALLY AVAILABLE PHOSPHORUS USING PROTEOLYTIC AEROMONAS HYDROPHILA,
Vermont Univ., Burlington. Dept. of Microbiology and Biochemistry.
A. I. Ratsep, and R. E. Sjogren.
Freshwater Biology, Vol. 14, No. 4, p 423-429, August, 1984. 4 Fig, 1 Tab, 30 Ref.

Descriptors: *Phosphorus compounds, *Bacterial physiology, *Aeromonas, *Bioassay, *Assay, Orthophosphates, Trophic level, Spectrophotometry, Phosphates.

Through enzymatic hydrolysis and excretion of organic acids by aquatic organisms, substantial quantities of biologically available phosphorus (BAP) from phosphorus containing compounds other than inorganic orthophosphate can easily be mobilized into the biological cycle. An assay procedure was developed as a first step in ascertaining whether or not the measurement of BAP could be used to assess the trophic state of freshwater lakes. BAP was measured by using Aeromonas hydrophila in a proteolytic assay system in which the release of the chromogen from an insoluble azure dye derivative of hide powder (HPA) was determined spectrophotometrically. The time necessary to hydrolyze 50% of the HPA was found to be directly dependent on the amount of BAP present. BAP within the range 2-250 micro g/L phosphate-phosphorus was detected. Various organic phosphorus compounds such as ADP, ATP, GMP, IMP, UMP, cytidylic acid, adenylic acid, as well as macromolecules RNA and DNA were usable as a source of BAP by A. hydrophyilla. BAP does not constitute a single phosphorus fraction but is found to occur naturally as a part of both organic and inorganic phosphorus compunds. Therefore, no physically definable phosphorus fraction(s) in the aquatic ecosystem can be measured chemically as BAP. Application of this assay for the measurement of BAP in freshwater offers the potential of monitoring the biological response of a freshwater ecosystem to phosphorus. (Collier-IVI)
W85-02285

CHROMATOGRAPHIC TRACE ANALYSIS OF GUANIDINE, SUBSTITUTED GUANIDINES AND S-TRIAZINES IN WATER,
Army Medical Bioengineering Research and Development Lab., Fort Detrick, MD.
E. P. Burrows, E. E. Brueggeman, and S. H. Hoke.
Journal of Chromatography, Vol. 294, p 494-498, June, 1984. 3 Fig, 1 Tab, 6 Ref.

Descriptors: *Guanidine, *Triazines, *Industrial wastewater, *Chromatography, Urea, Cyanamide, Thin layer chromatography, High performance liquid chromatography.

Nitroguanidine is a frequent component of military propellants. To insure that Army production facilities remain in compliance with wastewater discharge limits, we were tasked with development of highly sensitive analytical methods for determination of the trace organics known or suspected to be present in nitroguanidine production wastewater. These included nitrosoguanidine, cyanoguanidine, guanidine, urea, cyanamide, melamine, and ammeline, in addition to nitroguanidine. Until the emergence of reversed-phase high-performance liquid chromatography (RP-HPLC), separation and analysis of these small, highly polar compounds was generally limited to thin-layer chromatography (TLC) on cellulose in aqueous systems. Relative to HPLC, TLC procedures are insensitive (frequently by several powers of ten) and difficult to apply quantitatively because the compounds can only be visualized by chromogenic spray or dip reagents. Recently, RP-HPLC separations of nitroguanidine and nitrosoguanidine and of melamine and ammeline have been described. We here report two highly sensitive, reproducible, and rapid RP-HPLC methods for quantitative estimation of three substituted guanidines and two triazines, and their application to trace analysis of wastewater. Guanidine, classically determined by fluorescence spectrophotometry of the ninhydrin complex, has insufficient UV absorbance alone for detection by HPLC. We have developed a novel ion chromatographic method for its estimation, which was not subject to interference by other cations present in the wastewater. Cyanamide and urea were determined by spectrophotometric procedures described elsewhere. (Author's abstract)
W85-02303

GAS CHROMATOGRAPHIC METHOD FOR THE DETERMINATION OF ELEMENTAL SULPHUR IN SEDIMENTS,
Waterworks of Hajdu-Bihar County, Debrecen (Hungary).
C. Heim, I. Devai, and J. Harangi.
Journal of Chromatography, Vol. 295, No. 1, p 259-263, July, 1984. 2 Fig, 13 Ref.

Descriptors: *Pollutant identification, *Gas chromatography, *Sulfur, *Sediments, *Lake Balaton, Hungary, Lake sediments.

The sulfur circulation, the qualitative and quantitative determination of sulfur compounds arising from sediments and the bacterial background of the transformations were investigated in sediments from Lake Balaton. A method was required for determining small amounts of sulfur in the presence of large amounts of other sulfur compounds including sulfides, sulfites, and sulfates. For the extraction of sulfur from sediments n-hexane proved to be the best solvent. The chlorinated hydrocarbon components, adsorbed on the silica gel, could be eluted with benzene and used in pesticide analysis. The gas chromatographic analysis of elemental sulfur is based on the formation of hydrogen sulfide from sulfur in a hydrogen atmosphere below 300 degrees C. Using this method the elemental sulfur content of the sediment of Lake Balaton was determined and the results of seven measurements on the same sample gave minimal sulfur content, 170.80; maximum sulfur content, 186.20; average sulfur content, 179.74; and standard deviation, 5.00. (Baker-IVI)
W85-02305

ELECTROCHEMICAL PRECONCENTRATION COMBINED WITH ATOMIC ABSORPTION SPECTROMETRY FOR THE DETERMINATION OF HEAVY METALS IN WATER SAMPLES,
Bari Univ. (Italy). Dept. of Chemistry.
G. Torsi, and F. Palmisano.
Science of the Total Environment, Vol. 37, No. 1, p 35-40, July, 1984. 1 Tab, 23 Ref.

Descriptors: *Water analysis, *Heavy metals, *Atomic absorption spectrometry, *Electrochemical deposition, Pollutant identification, Trace metals.

The coupling of electrochemical deposition (ED) with atomic absorption spectrometry (AAS) as a means of suppressing matrix effects is reviewed. The coupling of ED with AAS represents an inter-

esting approach to the problem of trace metals determination in complex matrices. The ED step is particularly effective in separating and removing the analyte from the sample matrix, extending the working concentration range of AAS downward. In some cases this approach is the only one that succeeds in the AAS determination of heavy metals in the sub-ppb range. ED-AAS is particularly appealing compared to chemical preconcentration as it avoids long and tedious manipulations of the sample that are also responsible for serious contaminations. The main drawbacks of the ED-AAS methods are: the applicability to only those metals that can be electrodeposited and subsequently atomized, under actual working conditions; and the non-multielementary capabilities, that is, a single metal can be determined from a single deposition. Multielemental analysis coupled to a single deposition could be attempted with deposition on graphite, but the enhanced contamination risks and the long time required for the deposition step make the method impractical. (Baker-IVI)
W85-02307

ELECTROCHEMICAL SPECIATION AND DETERMINATION OF ORGANOMETALLIC SPECIES IN NATURAL WATERS,
Pisa Univ. (Italy). Ist. di Chimica Analitica.
M. P. Colombini, R. Fuoco, and P. Papoff.
Science of the Total Environment, Vol. 37, No. 1, p 61-70, July, 1984. 8 Fig, 2 Tab, 19 Ref.

Descriptors: *Pollutant identification, *Speciation, *Organolead compounds, Organometallic compounds, Lead, Electrochemical speciation, Tetraalkyllead.

The analytical problem to be solved in tetraalkyllead pollution of natural water is not merely restricted to the detection and determination of the non-ionic compounds, but, owing to the attitude of tetraalkyllead in giving R3Pb(+), R2Pb(2+), up to inorganic lead, and owing to the quite different poisoning effect of such compounds, the problem has to be extended to determining all the degraded products up to Pb(2+). A procedure is described for the consecutive determination of Me4Pb, Et4Pb, Me3Pb(+), Et3Pb(+), Me2Pb(2+), Et2Pb(2+), and inorganic Pb(2+) in a water sample. The method is based on selective organic phase extraction coupled with differential pulse electrochemical techniques. Once irreversible chemical reactions during sample handling have been avoided, the only equilibria to be considered concern, respectively, R3Pb(+), R2Pb(2+), and Pb(2+) ions, which in natural water may be shared among different complexes. The analysis can be carried out in 3 to 4 hr. Owing to the reactivity and the thermal instability of the organolead compounds, concentrating the solution by solvent evaporation is not possible. The detection limit for the optical detector in gas chromatography may be therefore too high in respect to the actual needs. This may account for the very few data reported in literature for organolead, as compared with those relevant to arsenic, mercury, selenium and tin compounds. (Baker-IVI)
W85-02309

ELECTROANALYSIS OF ORGANIC POLLUTANTS IN AQUATIC MATRICES,
University Coll., Cork (Ireland). Dept. of Chemistry.
W. F. Smyth, and J. A. Healy.
Science of the Total Environment, Vol. 37, No. 1, p 71-81, July, 1984. 3 Tab, 28 Ref.

Descriptors: *Pollutant identification, *Electrochemistry, Polarography, Voltammetry, Stripping voltammetry, Chromatography, Trace analysis, Aromatic compounds, Carbamates, Anilines, Benzidines, Carbonyl compounds, Organophosphorus compounds, Sulfur compounds.

The electroanalysis of organic pollutants in aquatic matrices is reviewed. Attention is directed to the application of polarography, voltammetry, stripping voltammetry and online electrochemical detection following high-performance liquid chromatography separation to the identification and determination of trace concentrations of selected groups of organic compounds and their metabolites in aquatic matrices. Where possible, a critical comparison is made between the methods and alternative analytical methods based primarily on chromatographic and spectroscopic techniques. Compounds included in the discussion include those with carbonyl groupings, soluble aromatic compounds (nitrocompounds, phenolic compounds, polychlorinated compounds), carboxylic acids, alkyl sulfonates and alkyl benzene sulfonates, organophosphorus compounds, compounds containing endocyclic and exocyclic azomethine groups, compounds containing the -SH group, carbamates, halogenated anilines, and benzidines. (Baker-IVI)
W85-02310

TECHNIQUES OF ELECTROCHEMICAL DETERMINATION OF ORGANIC POLLUTANTS IN WATER,
Ceskoslovenska Akademie Ved, Prague. J. Heyrovsky Inst. of Physical Chemistry and Electrochemistry.
M. Kopanica.
Science of the Total Environment, Vol. 37, No. 1, p 83-90, July, 1984. 3 Fig, 1 Tab, 23 Ref.

Descripors: *Water analysis, *Pollutant identification, *Electrochemistry, Trace analysis, Polarography, Voltammetry, Chromatography, Organic compounds, Thioureas, Trichlorophenyls, Surfactants.

Progressive polarographic and voltammetric techniques for analysis of trichlorobiphenyl thiourea and other compounds in water are discussed. A new type of electrochemical detector for high pressure liquid chromatography (HPLC) is described. Adsorptive accumulation of analyzed substances plays an important role in the polarographic or voltammetric analysis of organic compounds because in many cases this mode of analysis allows a decrease in the detection limits of the corresponding electrochemical determinations. How this principle can be applied to the determination of some pollutants in natural waters is discussed, with specific reference to trichlorobiphenyl, thiourea and related compounds, and surfactants and crude oil products. In analyses where low amounts of organic pollutants are present, electrochemical methods are advantageous due to their high sensitivity, but in some cases these methods lack selectivity. Interest is therefore focused on the combination of polarographic or voltammetric methods with effective separation techniques. The application of electrochemical detectors in high performance liquid chromatography is very promising. (Baker-IVI)
W85-02311

ELECTROCHEMICAL MEASUREMENT OF DISSOLVED OXYGEN IN WATER,
Ceskoslovenska Akademie Ved, Prague. J. Heyrovsky Inst. of Physical Chemistry and Electrochemistry.
L. Serak.
Science of the Total Environment, Vol. 37, No. 1, p 107-111, July, 1984. 3 Fig, 6 Ref.

Descriptors: *Dissolved oxygen, *Polarography, *Water quality control, *Monitoring, Natural waters, Wastewater analysis.

Polarographic estimation of dissolved oxygen has become very important in the analysis of biological systems, including natural and waste waters. The recessed indicator microelectrode was developed as a new type of sensor for use in the field. The decisive step in the research was the introduction of a membrane-covered sensor. Some practical aspects of the application of an electrochemical Clark-type sensor are discussed. One of the difficulties encountered in the use of this sensor is the electrolyte layer which is confined between the membrane and the surface of the indicator electrode. Attention is paid to improvement of its function, through the introduction of a spacer between the indicator electrode and the membrane to define the thickness and diameter of the layer of electrolyte close to the surface of the electrode. (Baker-IVI)
W85-02314

ELECTROCHEMICAL METHODS AND SENSORS FOR MONITORING OF WATER,
Ceskoslovenska Akademie Ved, Prague. J. Heyrovsky Inst. of Physical Chemistry and Electrochemistry.
For primary bibliographic entry see Field 7B.
W85-02315

ION SELECTIVE ELECTRODES FOR MEASUREMENTS IN FRESH WATERS,
Rome Univ. (Italy). Ist. di Chimica Analitica.
For primary bibliographic entry see Field 7B.
W85-02316

INFLUENCE OF SURFACTANTS ON THE DETERMINATION OF CU, PB, AND CD BY ASV,
Newcastle Univ. (Australia). Dept. of Chemistry.
A. Beveridge, and W. F. Pickering.
Water Research, Vol. 18, No. 9, p 1119-1123, 1984. 1 Fig, 1 Tab, 10 Ref.

Descriptors: *Water analysis, *Surfactants, *Copper, *Lead, *Cadmium, Voltammetry, Anodic stripping, Pollutant identification.

Small amounts of water soluble surfactants alter significantly the uptake of metal ions by clays, and in view of their sorptive/reactive properties an investigation was undertaken into the possible influence of the same range of these soluble surfactants on the anodic stripping voltammetric (ASV) behavior of microgram/liter levels of Cd, Pb, and Cu using analytical equipment marketed for environmental studies. The presence of commercial surfactants caused some changes in peak current with little change in peak position or width. In general, there tended to be 20% increases in Cu response, 10% enhancement of Pb peaks, and decreases in Cd systems containing higher concentrations of organic matter. Concentrations as low as 10 micrograms/l produced measurable effects. The response of Cu in particular was sensitive to pH. Cu peak heights were also markedly affected by the presence of low concentrations of chloride ions. The precision achieved with the ASV Analyzer varied with the element studied, and the state of the Hg film. The percentage relative standard error of the means derived from five successive deposition and stripping cycles was 5% for Cd and Pb, 12-14% for Cu. It is recommended that when analyzing waters suspected of containing surfactants, extra care be taken in the calibration stage. (Baker-IVI)
W85-02429

IMPROVED AMMONIA OXIDATION BY OZONE IN THE PRESENCE OF BROMIDE ION DURING WATER TREATMENT,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
W. R. Haag, J. Hoigne, and H. Bader.
Water Research, Vol. 18, No. 9, p 1125-1128, 1984. 1 Fig, 1 Tab, 14 Ref.

Descriptors: *Wastewater treatment, *Ozonation, *Ammonia, *Bromine, Chemical reactions, Ozone, Oxidation, Kinetics, Catalysts.

Ammonia oxidation by ozone proceeds more rapidly in the presence of bromide ion than in its absence. Unlike the direct ozonation of ammonia, the bromide-catalyzed process is little affected by changes in pH. A reaction scheme is proposed in which bromide is oxidized to HOBr, which then brominates ammonia to produce NG2Br.NH2Br which in turn reacts with ozone to form NO3(-) and also to generate Br(-), which thus acts as a catalyst. Ammonia depletion in the presence of a constant ozone concentration does follow zero-order kinetics, except perhaps at low Br(-) concentrations. The rates correlate linearly with the added Br(-) concentration but are essentially independent of pH or initial ammonia concentration. Part of the ammonia losses observed in this study could have been due to bromine ammonia breakpoint reactions. Ozonation of bromide containing water in the absence of ammonia can lead to the formation of bromoorganics and bromate due to the intermediate formation of HOBr. The presence

of ammonia which intercepts the HOBr to produce less reactive brominating agents should tend to retard such reactions. (Baker-IVI)
W85-02430

OPTIMAL MANUAL PROCEDURE FOR AMMONIA ANALYSIS IN NATURAL WATERS BY THE INDOPHENOL BLUE METHOD,
Institut Rudjer Boskovic, Zagreb (Yugoslavia). Center for Marine Research.
I. Ivancic, and D. Degobbis.
Water Research, Vol. 18, No. 9, p 1143-1147, 1984. 2 Fig, 3 Tab, 21 Ref. NSF grant F7F022Y.

Descriptors: *Ammonia, *Water analysis, *Indophenol blue method, Natural waters.

Experiments which lead to a modified analytical procedure for ammonia determination are presented. The Solorzano procedure using phenol-alcohol, nitroprusside, alkaline citrate and hypochlorite as reagents for determination of ammonia in water is considered suitable for routine analysis and has been widely adopted. Replacing the hypochlorite with sodium dichloro-iso-cyanurate, adding the catalyst after all other reagents, and increasing the working pH has resulted in improvements in this method. While concentration factors are statistically the same as in the original procedure, the reagent blanks are lower and the color develops faster, both in fresh and in sea water. (Baker-IVI)
W85-02433

COMPARISON OF METHODS FOR THE DETERMINATION OF CONDITIONAL STABILITY CONSTANTS OF HEAVY METAL-FULVIC ACID COMPLEXES,
Imperial Coll. of Science and Technology, London (England). Public Health Engineering Lab.
R. M. Sterritt, and J. N. Lester.
Water Research, Vol. 18, No. 9, p 1149-1153, 1984. 1 Fig, 1 Tab, 19 Ref.

Descriptors: *Water analysis, *Heavy metals, *Voltammetry, *Polarography, *Dialysis, *Ion-selective electrodes, Cadmium, Copper, Lead, Fulvic acid.

Values for the conditional stability constant K' for a particular set of defined experimental conditions of pH and ionic strength, and total ligand concentration (L') may be determined experimentally by titrating a ligand with metal ions using an analytical method to distinguish free metal from complexed metal. This study was undertaken to compare the values of K' and (L') for complex formation between fulvic acid and cadmium, lead and copper, in order to assess the influence of interference and selectivity of the analytical methods employed on the results obtained. The methods compared included the use of ion selective electrodes, dialysis and differential pulse anodic stripping voltammetry. Most information was obtained from the ion selective electrodes (ISE) which indicated that all three metals formed two types of complex with the fulvic acid. Weak cadmium complexes were undetectable when dialysis was used to separate bound and free metal. Only the stronger complexes of copper and cadmium were detected by polarography. The stability constant of the copper complex determined by polarography was lower than the equivalent values obtained from the other techniques, suggesting partial lability, while the lead complex was completely undetectable. The ISE analysis appeared to give the most reliable results in terms of applicability and sensitivity. (Baker-IVI)
W85-02434

DETERMINATION OF BROMIDE IN NATURAL WATERS BY ION CHROMATOGRAPHY USING A CONCENTRATOR COLUMN,
Tennessee Univ., Knoxville. Dept. of Civil Engineering.
C. M. Morrow, and R. A. Minear.
Water Research, Vol. 18, No. 9, p 1165-1168, 1984. 3 Fig, 3 Tab, 12 Ref.

Descriptors: *Water analysis, *Bromides, *Ion chromatography, *Concentrator columns, Chromatography, Sulfates, Nitrates, Chlorides, Natural waters.

When using conventional ion chromatography (IC) separation techniques, it is possible that other matrix anions also common to natural waters may coelute with bromide. Separation of bromine from all other matrix anions was shown to be possible using a trace anion separator, a standard anion suppressor and slightly weakened standard eluent at 30% flow. Qualitative analysis of micro g/l levels of bromine in the presence of high concentrations of other ions possessing higher affinities for the column than bromide can lead to less than 100% retention of bromide, in the event that the micro-equiv capacity of the concentrator column is exceeded. In the presence of 100 mg/l chloride, there was 100% recovery of 80 microg/l bromide. In the presence of 100 mg/l NO3(-), only 16.2% of the bromide was recovered, and there was no response for 80 micrograms/l Br(-) in the presence of 1000 mg/l sulfate, indicating 0% recovery. Evaluation of micro-equiv concentrator capacity yielded 8.5, 10.6, 6.8, 13.9, 11.7, and 14.6 for the 6 columns subjected to analysis. Evaluation of the concentrator found to possess the highest micro-equiv capacity (14.6) for percent recoveries of 80 micro g/l bromide in the presence of varying amounts of nitrate and sulfate, at a concentration of 50 ml, revealed that nitrate in excess of 17 mg/l and that sulfate in excess of 25 mg/l interfered with the elution of bromide. In the absence of interfering constituents, results of the IC and spectrophotometric analysis are quite comparable and may be used to validate one another. Use of the IC method for general analyses coupled with the capacity for backup analyses by the spectrophotometric method to allow for validation of the IC data is preferable. (Baker-IVI)
W85-02436

RAPID METHOD FOR SEPARATING PHOSPHORUS COMPOUNDS BY MOLECULAR WEIGHT USING EXCLUSION GELS AND CENTRIFUGATION,
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
P. Brassard, and J. C. Auclair.
Water Research, Vol. 18, No. 9, p 1181-1183, 1984. 2 Fig, 9 Ref.

Descriptors: *Phosphorus, *Water analysis, *Lakes, *Gels, Organic compounds, Chromatography, Centrifugation, Batch analysis.

The separation of the various phosphorus compounds present in lakewaters is needed to assess their availability and role in algal assemblages. Separating these compounds by gel chromatography can take several hours, and denaturation can occur during that time. It is possible to accelerate the procedure by using several batch extractions in sequence. The method described allows the simultaneous analysis of 4 samples in about 20 minutes using Sephadex G-25 exclusion gel. After a suitable preparation the gel is packed in a small cylindrical extractor and centrifuged to near dryness. The gel is then spiked with sample no greater than the void volume of the gel. The first extract is forced out of the bed by centrifugation and collected. Then, an identical volume of eluent solution is added to the dry gel, allowing it to swell again. A second extract is centrifuged out, to be followed by another eluent addition. The process is repeated until 10 extracts, including the first one, are collected. By that time all the sample should have left the gel bed. The whole molecular weight profile of the sample is thus spread over the 10 extracts, with the void volume at the first one. The gain in time is obtained at the expense of resolution since the shallow elution profile is spread over 10 samples. The method is simple and efficient in applications where the speed of separation is more important than resolution. (Baker-IVI)
W85-02439

UNRELIABILITY OF THE KINETIC APPROACH TO MEASURING BACTERIAL MINERALIZATION ACTIVITIES AT LOW IN SITU TEMPERATURES IN AN ACIDIC AQUATIC ENVIRONMENT,
Laurentian Univ., Sudbury (Ontario). Dept. of Biology.
G. D. Ferroni, and L. G. Leduc.
Water Research, Vol. 18, No. 9, p 1185-1188, 1984. 3 Fig, 1 Tab, 23 Ref.

Descriptors: *Bacteria, *Mineralization, *Water analysis, *Kinetics, *Whitson Lake, *Ontario, Acidic waters, Heterotrophic activity method, Glucose.

The kinetic approach was used to determine the rates of glucose mineralization in Whitson Lake, situated 12 km north of Sudbury, Ontario. Water samples showed the lake to be moderately acidic. Plots of the amount of glucose mineralized vs time of incubation were linear at both high and low concentrations of added glucose. When sample water buffered around the in situ pH was used in these time studies, linear relationships were again evident, but there was a reduction in the rates of glucose mineralization activity. Even so, the kinetic approach usually failed to generate the Michaelis-Menten response at the necessary level of statistical significance to justify calculations of turnover times and V(max) values. And, buffering the pH around the in situ pH did not insure that the Michaelis-Menten response would be obtained. Previously it had been reported that the heterotrophic activity method was unreliable when applied to the water column of an extremely acidic lake (Leduc, L.G. and Ferroni G.D., 1984 Water Res. 18, 609-612). The results of this study show the method, as currently in use, is also unreliable when applied to the open water of less acidic lakes. (Baker-IVI)
W85-02440

ISOLATION OF PATHOGENIC BACTERIA PRESENT IN WATER USING IMMUNOABSORBENTS (ISOLEMENT DE BACTERIES PATHOGENES CONTAMINANT UNE EAU A L'AIDE D'IMMUNOADSORBANTS),
Institut Pasteur, Paris (France). Dept. d'Immunologie.
B. Guilbert, B. Goud, M. Guillou, S. Avrameas, and A. Dodin.
Water Research, Vol. 18, No. 9, p 1189-1191, 1984. 1 Tab, 7 Ref.

Descriptors: *Immunoabsorbents, *Bacteria, Drinking water, Water quality control, Public health, Bacterial analysis.

A method is described which allows direct isolation from water of the main pathogenic bacteria which are common fecal contaminants. These include Salmonella typhimurium, Escherichia coli K 88 and K 99 and Vibrio cholerae of the El Tor biotype. Contaminated water is filtered through small immunoabsorbant columns packed with polyacrylamide-agarose beads coupled to specific antibodies against bacterial antigenic structures. Water samples containing a mixture of 1000 of each of the four bacteria were filtered through beads coated with different antibodies. Bacteria retained on the beads were only those against which antibodies were directed. Analysis of the column effluent waters after passing 1000 bacteria through the relevant columns showed no bacteria after filtration, suggesting most of the bacteria were retained on the beads. Bacteria were found in column effluent waters when the water samples contained more than 100,000 bacteria. This technique is highly specific and allows the filtration of relatively large quantities of water. (Baker-IVI)
W85-02441

FOREIGN ELEMENTS IN A CLAM SHELL: A CLUE TO THE HISTORY OF MARINE POLLUTION EVENTS,
National Sun Yat-Sen Univ., Kaohsiung (Taiwan). Inst. of Marine Biology.
L.-S. Fang, and P. Shen.
Marine Ecology Progess Series, Vol. 18, No. 1-2, p 187-189, June, 1984. 2 Fig, 12 Ref.

Descriptors: *Shells, *Clams, *Monitoring, Marine environments, Water pollution effects, Calcium, Zinc, Sulfur, Iron, Zinc, Chlorine.

Individuals of the clam Meretrix lusoria were collected from a shallow-water culture farm in Taiwan. The shells were analyzed using scanning electron microscopy combined with energy dispersive analysis by X-ray. In the inner and intermediate layers only Ca was detected. Significant amounts of Ca, S, and Fe, with minute amounts of Cu, Zn and Cl were detected in the outer layer (periostracum). The maximum quantity of the elements studied was found at the surface and along the edges of the shell. Foreign elements accumulate on the outer surface of the shell and the amounts of S, Fe, Cu and Zn decrease with age; this indicates that caution is necessary when using shells as a monitor for environmental pollution. When clams with large, thick shells are analyzed for bulk composition, the degree of pollution may be considerably underestimated. (Moore-IVI)
W85-02541

DEVELOPMENT AND USE OF AN AQUATIC MICRO-ECOSYSTEM AS A TEST SYSTEM FOR TOXIC SUBSTANCES. PROPERTIES OF AN AQUATIC MICRO-ECOSYSTEM IV,
Rijksinstituut voor Natuurbeheer, Leersum (Netherlands).
K. Kersting.
Internationale Revue der Gesamten Hydrobiologie, Vol. 69, No. 4, p 567-607, 1984. 22 Fig, 1 Tab, 33 Ref.

Descriptors: *Ecosystems, *Toxicity, *Herbicides, Daphnia, Chlorella, Bacteria, Algae, Cyanophyta, Dichlorbenil, Diuron, Regression analysis, Stress.

A series of experiments was performed with micro-ecosystems, using several modifications of a micro-ecosystem made up of three subsystems connected by a unidirectional flow of recirculating water. The three subsystems represent roughly the trophic levels of autotrophs (algae), herbivores (Daphnia magna), and decomposers (sand filter with bacteria). The particle concentration was determined weekly, using a Coulter Counter, and the Daphnia population was counted. The experimental conditions did not prevent contamination of the system by algae. Other species than the seeded Chlorella emerged in the systems. The resulting species composition was variable, and usually cyanobacteria became dominant after a period. Possibly, the low light intensity was responsible for the succession. The Daphnia population and the algal concentration varied considerably with time, and a slightly decreasing trend was usually observed. In several micro-ecosytems, the herbicide dichlobenil was introduced once or several times, and in one micro-ecosystem, the herbicide diuron was added. Dichlobenil at 1 ppm had no effect. Diuron as a granulate at a dosage of 0.2 ppm led to a drastic decrease of the algal concentration, and the simultaneous death of the Daphnia population. The algal concentrations and the Daphnia numbers were correlated to each other by regression analysis and according to a dynamic system approach. In both cases, the effect of herbicides was better discerned than in the separate analysis of the data. In the dynamic systems approach, a normalized ecosystem strain was defined as a parameter to measure effects of stress on the ecosystem level. (Moore-IVI)
W85-02570

RELATIONSHIPS AMONG OBSERVED METAL CONCENTRATIONS, CRITERIA, AND BENTHIC COMMUNITY STRUCTURAL RESPONSES IN 15 STREAMS,
Nevada Univ., Las Vegas. Dept. of Biological Sciences.
T. W. LaPoint, S. M. Melancon, and M. K. Morris.
Journal of the Water Pollution Control Federation, Vol. 56, No. 9, p 1030-1038, September, 1984. 10 Fig, 2 Tab, 55 Ref.

Descriptors: *Bioindicators, *Water quality, *Metals, *Benthic fauna, Streams, Monitoring, Water pollution effects, Watersheds, Land use.

Fifteen streams were chosen to provide broad geographical representation and a wide range of watershed types and uses, pollution sources, water quality characteristics, biota, and habitats. The primary objectives were to document the concentration and distibution of toxic metals in the streams, determine the biological state of the receiving waters where the aquatic life criteria for metals were exceeded, report the extent to which criteria levels were exceeded, and develop explanatory hypotheses when healthy biota existed where criteria were exceeded. In general, the study supports the supposition that benthic fauna can reflect changes in water quality. It is suggested that a seasonal monitoring regime be used in which the sampling schedule is based on critical flow periods, to assess the toxicity of effluent discharges to the aquatic fauna. Only known seasonal invertebrate responses will allow a determination of whether a given criterion is adequate or overprotective for aquatic communities. (Baker-IVI)
W85-02584

ANAEROBIC INCUBATION OF MEMBRANE FILTER CULTURES FOR IMPROVED DETECTION OF FECAL COLIFORMS FROM RECREATIONAL WATERS,
Arizona Univ., Tucson. School of Renewable Natural Resources.
J. D. Doyle, B. Tunnicliff, S. K. Brickler, R. E. Kramer, and N. A. Sinclair.
Applied and Environmental Microbiology, Vol. 48, No. 2, p 324-326, August, 1984. 1 Fig, 1 Tab, 19 Ref. Forest Service grant RM-81-161-GR.

Descriptors: *Anaerobic incubation, *Membrane filtration, *Fecal coliforms, Recreational waters, Water quality, Beaches, Bacterial analysis.

Membrane filtration (MF) is the method of choice for monitoring recreational water quality, because of ease of use, applicability to large sample volumes, precision, and rapidity of results. The use of this technique for natural waters is sometimes hampered by high background densities of nonfecal coliforms. Anaerobic incubation of MF cultures significantly enhanced detection of fecal coliforms in surface-water samples from recreational beaches. In contrast to standard aerobic incubation, anaerobic incubation suppressed overgrowth of masking, noncoliform bacteria but did not increase the frequency of fecal coliform recovery. The simplicity and low cost of anaerobic incubation as adapted to the MF procedure may allow agencies which monitor recreational water quality to make expedient management decisions based on more reliable data. (Moore-IVI)
W85-02595

ISOLATION OF AEROMONAS HYDROPHILA FROM A METROPOLITAN WATER SUPPLY: SEASONAL CORRELATION WITH CLINICAL ISOLATES,
Princess Margaret Children's Medical Research Foundation, Perth (Australia).
For primary bibliographic entry see Field 5F.
W85-02596

ISOLATION OF AEROMONAS SPP. FROM AN UNCHLORINATED DOMESTIC WATER SUPPLY,
Princess Margaret Children's Medical Research Foundation, Perth (Australia).
For primary bibliographic entry see Field 5F.
W85-02597

EVALUATION OF M-T7 AGAR AS A FECAL COLIFORM MEDIUM,
Montana State Univ., Bozeman. Dept. of Microbiology.
M. W. LeChevallier, P. E. Jakanoski, A. K. Camper, and G. A. McFeters.
Applied and Environmental Microbiology, Vol. 48, No. 2, p 371-375, August, 1984. 3 Fig, 2 Tab, 14 Ref. EPA grant R807092.

Descriptors: *Fecal coliforms, *Injured coliforms, *Culture media, Effluents, Chlorination, Bacterial analysis, Coliforms, Wastewater treatment.

Coliforms in chlorinated sewage effluents may be stressed or injured and may not grow when selective media are used. A medium (m-T7 agar) designed to improve recoveries of injured total coliforms was evaluated for its effectiveness as a fecal coliform medium. Time and temperature of preincubation were crucial to the optimal recovery of fetal coliforms. Isolation rates for fecal coliforms on m-T7 agar from sewage effuents were the highest when plates were preincubated at 37 C for 8 h before transfer to 44.5 C for 12 h. The medium produced consistently higher fecal coliform counts than all other methods tested. Recoveries were 3.1 times greater than the standard m-FC method and 1.7 times greater than the two-layer enrichment, temperature acclimation procedure. Verification rates for fecal coliforms isolated on m-T7 agar averaged 89.0%, whereas verification rates for m-FC agar averaged only 82.8%. Both media isolated similar fecal coliform populations. Results of the study indicate that 66.8% of the coliforms in the chlorinated sewage effluents examined were injured. (Moore-IVI)
W85-02598

ISOLATION OF ENTEROVIRUSES FROM WATER, SUSPENDED SOLIDS, AND SEDIMENTS FROM GALVESTON BAY: SURVIVAL OF POLIOVIRUS AND ROTAVIRUS ADSORBED TO SEDIMENTS,
Baylor Coll. of Medicine, Houston, TX. Dept. of Virology and Epidemiology.
V. C. Rao, K. M. Seidel, S. M. Goyal, T. G. Metcalf, and J. L. Melnick.
Applied and Environmental Microbiology, Vol. 48, No. 2, p 404-409, August, 1984. 1 Fig, 7 Tab, 34 Ref.

Descriptors: *Enteroviruses, *Poliovirus, *Rotavirus, *Suspended solids, *Sediments, *Galveston Bay, *Texas, Estuarine environment, Seawater, Viruses, Water pollution.

The distribution and quantitation of enteroviruses among water, suspended solids, and compact sediments in a polluted estuary are described. Samples were collected sequentially from water, suspended solids, fluffy sediments (uppermost layer of bottom sediments), and compact sediment. A total of 103 samples were examined of which 27 (26%) were positive for virus. Polioviruses were recovered most often, followed by coxsackie B viruses and echoviruses 7 and 29. Virus was found most often attached to suspended solids: 72% of these samples were positive, whereas only 14% of water samples without solids yielded virus. Fluffy sediments yielded virus in 47% of the samples, whereas only 5% of compact bottom-sediment samples were positive. When associated with solids, poliovirus and rotavirus retained their infectious quality for 19 days. The same viruses remained infectious for only 9 days when freely suspended in seawater. Collection of suspended solids at ambient water pH appears to be very useful for the detection of virus; it has advantages over collecting and processing large volumes of water, with accompanying pH adjustment and salt addition for processing. (Author's abstract)
W85-02599

APPLICATION OF DERIVATIVE SPECTROSCOPY IN BIOASSAYS ESTIMATING ALGAL AVAILABLE PHOSPHATE IN LAKE SEDIMENTS,
Hoogheemraadschap van Rijnland, Leiden (Netherlands).
C. Bruning, and S. P. Klapwijk.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 1, p 172-178, July, 1984. 4 Fig, 1 Tab, 20 Ref.

Descriptors: *Spectroscopy, *Bioassays, *Lake sediments, *Phosphates, Acidity, Algae, Biomass, Hydrogen ion concentration.

The derivative spectroscopy technique is shown to be a very quick, sensitive and reliable biomass parameter in bioassays which are disturbed by sediment. It can even be used in sediment/algal mixtures, where only 6% of the total absorption (at 680 mm) is caused by the presence of algae. Therefore the technique can perhaps also be applied to determine the presence of algae in natural sedi-

ments. The study also demonstrated that the rising pH in bioassays with sediment can greatly increase the availability of sediment phosphates. In this study the potentially occurring precipitation of calcite with coprecipitation of phosphate did not balance the release of iron and aluminum bound phosphates from the sediments at higher pH levels. (Baker-IVI)
W85-02615

5B. Sources Of Pollution

ACCUMULATION AND FATE OF TRI-N-BUTYLTIN CATION IN ESTUARINE BACTERIA,
National Bureau of Standards, Gaithersburg, MD. Center for Materials Science.
W. R. Blair, G. J. Olson, F. E. Brinckman, and W. P. Iverson.
Microbial Ecology, Vol. 8, No, 3, p 241-251, 1982. 3 Fig, 3 Tab, 34 Ref.

Descriptors: *Bacteria, *Butyltin, *Bioaccumulation, *Fate of pollutants, Chesapeake Bay, Metabolism, Organotin compounds, Estuarine environment, Biocides.

Organotins are being used in increasing amounts as plastics stabilizers, catalysts, and biocides. Estuarine bacteria resistant to tributyltin were studied to examine the mode of tributyltin accumulation and possible degradation and/or detoxification processes. Eight tributyltin-resistant bacterial isolates obtained from Baltimore Harbor, Chesapeake Bay, and three other resistant strains were used in the studies. The bacterial isolates accumulated tributyltin to 3.7-7.7 mg tin per g dry weight of cells by nonenergy requiring process, probably by adsorption to the cell envelope. Chemical speciation of cell extracts and culture media by combined liquid chromatography-atomic absorption spectrophotometry and tin-selective purge and trap flame photometric gas chomatography for possible tributyltin degradation products revealed no significant biotransformation of tributyltin cation by the tributyltin-resistant isolates. Apparently the isolates accumulate, but do not metabolize tributyltin. (Moore-IVI)
W85-02185

SURVIVAL AND VIABILITY OF NONCULTURABLE ESCHERICHIA COLI AND VIBRIO CHOLERAE IN THE ESTUARINE AND MARINE ENVIRONMENT,
Shandon Coll. of Oceanography (China). Dept. of Marine Biology.
H.-S. Xu, N. Roberts, F. L. Singleton, R. W. Attwell, and D. J. Grimes.
Microbial Ecology, Vol. 8, No. 4, p 313-323, 1982. 4 Fig, 2 Tab, 24 Ref. PHS grant 5R22-AI-14242, NSF grant DEB 77-14646, National Sea Grant NA81AA-D-00040, NOAA grant NA79AA-D-00062 and WHO grant C6/181/70.

Descriptors: *Bacteria, *Bioindicators, *Estuarine environment, *Marine environment, *Viability, *Survival, Fate of pollutants, Pathogenic bacteria, Vibrio, Escherichia, Public health.

Plating methods for estimating survival of indicator organisms, such as Escherichia coli, and waterborne pathogens including Vibrio cholerae, have severe limitations when used to estimate viable populations of these organisms in the aquatic environment. By combining the methods of immunofluorescent microscopy, acridine orange direct counting, and direct viable counting, with culture methods such as indirect enumeration by most probable number (MPN) estimation and direct plating, it was shown that both E. coli and V. cholerae undergo a 'nonrecoverable' stage of existence, but remain viable. Following 2-week incubations in saltwater (5-25% NaCl) microcosms, total counts, measured by direct microscopic examination of fluorescent antibody and acridine orange stained cells, remained unchanged, whereas MPN estimates and plate counts exhibited rapid decline. Results of direct viable counting, a procedure permitting estimate of substrate-responsive viable cells by microscopic examination, revealed that a significant proportion of the nonculturable cells were, indeed, viable. Thus, survival of pathogens in the aquatic environments must be re-assessed. The 'die-off' or 'decay' concept may not be completely valid. Furthermore, the usefulness of the coliform and fecal indices for evaluating water quality for public health purposes may be seriously compromised, in the light of the finding. (Author's abstract)
W85-02186

WATERBORNE TRANSMISSION OF CAMPYLOBACTER ENTERITIS,
Center for Infectious Diseases, Atlanta, GA. Div. of Bacterial Diseases.
For primary bibliographic entry see Field 5F.
W85-02188

DISTRIBUTION AND POSSIBLE INTERRELATIONSHIPS OF PATHOGENIC AND NONPATHOGENIC ACANTHAMOEBA FROM AQUATIC ENVIRONMENTS,
American Type Culture Collection, Rockville, MD.
P. M. Daggett, T. K. Sawyer, and T. A. Nerad.
Microbial Ecology, Vol. 8, No. 4, p 371-386, 1982. 2 Fig, 2 Tab, 26 Ref. NIH contract N01-RR-9-2104 and NSF DEB 7907336.

Descriptors: *Acanthamoeba, *Marine environment, *Coastal waters, *Distribution, Sludge disposal, Ocean dumping, Pathogenic protozoa, Protozoa, Marine sediments.

An overview of surveys on the distribution of Acanthamoeba spp. in marine, coastal waters, and tributaries of the northeastern US coast is presented. To confirm the species assignments, based upon morphological criteria, selected strains from these environments were compared isoenzymatically with pathogenic and nonpathogenic Acanthamoeba from other environments. The interrelationships among the strains examined, based on this analysis, are also reported. There appears to be particular association between the presence of Acanthamoeba in marine sediments and the sites of oceanic sludge dumping. Starch gel electrophoretic analysis of enzymes suggests that some isolates of Acanthamoeba from oceanic sludge dump-sites are not members of previously recognized pathogenic species. Current laboratory methods provide only a conservative estimate of the frequency with which Acanthamoeba are recovered from environmental samples. Continued research on methodology, ecology, and distribution of Acanthamoeba should confirm present indications that they are universally distributed in soil, water, and marine sediments. (Moore-IVI)
W85-02189

PARTITIONING AND SHORT-TERM PERSISTENCE OF FENITROTHION IN NEW BRUNSWICK (CANADA) HEADWATER STREAMS,
Maritimes Forest Research Centre, Fredericton (New Brunswick).
D. C. Eidt, A. J. Sosiak, and V. N. Mallet.
Archives of Environmental Contamination and Toxicology, Vol. 13, No. 1, p 43-52, January, 1984. 1 Fig, 11 Tab, 31 Ref.

Descriptors: *Fenitrothion, *Fate of pollutants, *Stream pollution, *New Brunswick, Insecticides, Suspended matter, Liverworts, Insects, Sediment contamination, Aquatic plants, Aquatic animals, Pesticide residues.

Fenitrothion is one of the principal insecticides used to minimize damage to the northeastern spruce-fir forest by the spruce budworm. There is reason for concern if fenitrothion or toxic degradation products concentrate and persist in compartments of the environment where they may affect organisms that find their niches in these compartments. Two streams were sprayed from the banks with a backpack mist blower, one with emulsifiable concentrate in water, and the other with an oil-based formulation. There were no consistent differences in concentration of fenitrothion in streamwater with depth, or between midstream and slow water at the stream edge. This was true of both aqueous and oil-based formulations. A large proportion of the fenitrothion was taken up by suspended material; in sediment, it was taken up mainly by the organic fraction. Concentrations of fenitrothion were above prespray values in most plants and insects sampled, and in some, above peak concentrations found in the water. Highest and most persistent residues were found in a liverwort. Highest residues in an animal were found in black fly larvae, perhaps explained by their filter-feeding on suspended matter with high fenitrothion concentrations. Peak concentrations in plants and animals usually occurred at 6 or 24 hr postspray sampling times, and in all cases decreased thereafter. Aminofenitrothion and fenitrooxon in sediments and 3-methyl-1-4-nitrophenol in plants and insects were seldom and inconsistently detected. It was confirmed that fenitrothion disappears rapidly in streamwater, including the suspended matter, as it flow downstream. (Moore-IVI)
W85-02190

PRESENCE AND BIOMAGNIFICATION OF ORGANOCHLORINE CHEMICAL RESIDUES IN OXBOW LAKES OF NORTHEASTERN LOUISIANA,
Missouri Univ.-Columbia. School of Forestry, Fisheries and Wildlife.
K. R. Niethammer, D. H. White, T. S. Baskett, and M. W. Sayre.
Archives of Environmental Contamination and Toxicology, Vol. 13, No. 1, p 63-74, January, 1984. 4 Fig, 6 Tab, 30 Ref.

Descriptors: *Organochlorines, *Pesticides, *Lake Bruin, *Lake Providence, *Lake St. John, *Louisiana, *Biological magnification, Polychorinated biphenyls, DDT, Toxaphene, Organic compounds.

Ninety-eight samples of 16 species of animals were collected at Lake Providence, 88 samples of 15 species at Lake Bruin, and 21 samples of 5 species at Lake St. John, Louisiana between July and September of 1980. In these samples residues of 13 different organochlorine compounds were found. The lakes act as sumps, accumulating residues from nearby agricultural land, and allowing substantial concentrations of many of these compounds to build up in the food webs. The principal organochlorines detected were DDT and its metabolites, toxaphene, and polychlorobiphenyls. Biomagnification was clearly illustrated in most cases. It is suggested that residue level in immature green-backed herons and one or more of the longer-lived predators such as snakes, gars, or largemouth bass could be monitored to evaluate levels of organochlorine chemical contaminants in aquatic habitats. (Baker-IVI)
W85-02191

IDENTIFICATION AND MEASUREMENT OF COMPONENTS IN GASOLINE, KEROSENE, AND NO. 2 FUEL OIL THAT PARTITION INTO THE AQUEOUS PHASE AFTER MIXING,
Health Effects Research Lab., Cincinnati, OH.
W. E. Coleman, J. W. Munch, R. P. Streicher, H. P. Ringhand, and F. C. Kopfler.
Archives of Environmental Contamination and Toxicology, Vol. 13, No. 2, p 171-178, March, 1984. 6 Fig, 3 Tab, 15 Ref.

Descriptors: *Oil spills, *Hydrocarbons, *Gasoline, *Kerosene, *Fuel oil, Water soluble fraction, Aromatic compounds, Fate of pollutants.

The water-soluble fractions (WSF) of gasoline, kerosene, and No. 2 fuel oil were added to drinking water and extracted into the aqueous phase under simulated field conditions. Initial aspects of the study dealt with the identification and distribution of the major components to the aqueous phase using pentane extraction and capillary column gas chromatography/mass spectrometry (GC/MS) for analyses. For all three fuels, aromatics comprised 50% or less of the weight of the product when analyzed directly. In each case aromatics comprised >93% by weight of the WSF. The largest weight percentages of the WSF were represented by C8 aromatics in gasoline (35%), C10 aromatics in kerosene (33%), and C11 aromatics in No. 2 fuel

oil (40%). Any toxicological and biological testing should be concentrated on aromatic compounds, particularly C6-C13 benzenes and naphthalenes. It may be feasible to use UV absorption analyses of the WSF as a gross parameter for measuring aromaticity to correlate with mutagenic activity. (Moore-IVI)
W85-02199

CHARACTERIZATION OF ORGANIC COMPOUNDS IN SIMULATED RAINFALL RUNOFFS FROM MODEL COAL PILES,
Texas Univ. Health Science Center at Houston. School of Public Health.
R. G. Stahl, Jr., J. G. Liehr, and E. M. Davis.
Archives of Environmental Contamination and Toxicology, Vol. 13, No. 2, p 179-190, March, 1984. 6 Fig, 6 Tab, 38 Ref.

Descriptors: *Coal, *Water pollution sources, *Organic compounds, Rainfall runoff, Simulation, Sulfur, Phenanthrene, Aliphatic compounds, Polycyclic aromatic hydrocarbons, Hydrocarbons.

Model coal piles were constructed and leached with distilled water under simulated rainfall conditions. The piles were composed of one of four coals: two of high sulfur content (Illinois No. 6 and Western Kentucky), one of low sulfur content (Montana Nerco), and one of variable sulfur content (Texas lignite). There were nine rainfall simulations spaced 15 days apart. The runoffs were collected, extracted at acid and base pH, and analyzed by capillary column gas chromatography/mass spectrometry (GC/MS). Also, an extreme case was simulated by stir-extracting a coal with three different organic solvents in an acid and base medium, and the extracts were analyzed by GC/MS. The most common organic compound identified in any extract was phenanthrene. Aliphatic hydrocarbons and polycyclic aromatic hydrocarbons (PAHs), and methyl and ethyl substituted PAHs were also identified. The concentration of most of the compounds did not exceed 50 micro g/L. The concentrations of compounds in the extreme case simulations ranged from below detection (< 1 micro g/L) up to 107 micro g/L. The data demonstrated that runoffs from coal piles may contain numerous organic compounds including many PAHs. (Author's abstract)
W85-02200

LEACHING OF OXIDATION PRODUCTS OF ALDICARB FROM GREENHOUSE SOILS TO WATER COURSES,
Institute for Pesticide Research, Wageningin (Netherlands).
M. Leistra, A. Dekker, and A. M. M. van der Burg.
Archives of Environmental Contamination and Toxicology, Vol. 13, No. 3, p 327-334, May, 1984. 5 Fig, 5 Tab, 12 Ref.

Descriptors: *Greenhouses, *Aldicarb, *Leaching, Pesticides, Water pollution sources, Pesticide residues, Computer models, Aldoxycarb, Irrigation rate, Greenhouse soils.

The transformation kinetics of the insecticide/nematicide aldicarb were studied in three greenhouse soils. Most of the aldicarb applied to soil oxidizes rapidly to aldicarb-sulfoxide, and a fraction of this oxidizes further to aldoxycarb. The transformation rates of the parent compound and its first oxidation product were high, while the amounts of aldoxycarb remained low. The transformation and movement of aldicarb and its oxidation products in a simplified greenhouse-soil system were simulated with a computation model. When the highest transformation rates were introduced into the computations in combination with high irrigation rates, the computed leaching was only 0.006% of the dose, with a maximum concentration of 0.15 micro g/L in the tile-drain water. With lower transformation rates, the computed leaching was 1.39% of the dose with a maxiumvm concentration of 21.0 micro g/L, but in combination with a lower irrgation rate the leaching was computed to be much less. Water from drain pipes and pits was sampled in three greenhouses that had received regular applications of aldicarb: the concentrations measured by high performance liquid chromatography (HPLC) varied from less than 1 micro g/L to more than 30 micro g/L. Most of the concentrations measured in water courses in an area with many greenhouses were low, but some were high, ranging up to 21 micro g/L. With lower irrigation rates, the leaching of mobile pesticide residues from greenhouse soils to water courses could be much less. An even distribution of irrigation water and a decrease in the gift of irrigation water per event could contribute to such a reduction. (Moore-IVI)
W85-02208

ACCUMULATION OF TRACE ELEMENTS, PESTICIDES, AND POLYCHLORINATED BIPHENYLS IN SEDIMENT AND THE CLAM CORBICULA MANILENSIS OF THE APALACHICOLA RIVER, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
J. F. Elder, and H. C. Mattraw, Jr.
Archives of Environmental Contamination and Toxicology, Vol. 13, No. 4, p 453-469, July, 1984. 11 Fig, 9 Tab, 56 Ref.

Descriptors: *Apalachicola River, *Florida, *Trace elements, *Pesticides, *Clams, *Polychlorinated biphenyls, Organic compounds, Heavy metals, Sediment contamination, Detritus, Water pollution sources.

A survey of trace element and synthetic organic compound concentrations in bottom materials was conducted on the Apalachicola River in northwest Florida in 1979-80 as part of the Apalachicola River Quality Assessment. Substances analyzed included trace elements (predominantly heavy metals), organochlorine insecticides, organophosphorus insecticides, chlorinated phenoxy-acid herbicides, and polychlorinated biphenyls (PCBs). Three kinds of materials were surveyed: fine-grained sediments, whole-body tissue of the Asiatic clam Corbicula manilensis, and bottom-load organic detritus. No hazardous levels of any of the substances were found. Concentrations in the fine-grained sediments and clams were generally at least ten times lower than maximum limits considered safe for biota of aquatic systems. A comparison of trace-substance data from the Apalachicola River with data from Lake Seminole (upstream) and Apalachicola Bay (downstream) showed lower concentrations in riverine clams. Sediment concentrations in all parts of the system were comparable. Most trace substances in the Apalachicola River enter the river from the upstream part of the basin (the Chatahoochee and Flint Rivers in Georgia and Alabama) and from nonpoint sources throughout the basin. There are no major point discharges along the Apalachicola. Trend analysis was limited by the scope of the study but did not reveal any spatial or temporal trends in concentrations of any of the substances analyzed. Concentrations of organic compounds and most metals in Corbicula manilensis did not correlate with those in sediments. (Author's abstract)
W85-02213

FATE OF HEXACHLOROCYCLOPENTADIENE IN WATER AND GOLDFISH,
Illinois Univ. at Chicago Circle. Dept. of Biological Sciences.
A. A. Podowski, and M. A. Q. Khan.
Archives of Environmental Contamination and Toxicology, Vol. 13, No. 4, p 471-481, July, 1984. 3 Fig, 5 Tab, 31 Ref.

Descriptors: *Hexachlorocyclopentadiene, *Fate of pollutants, *Goldfish, Degradation, Industrial wastes, Biotransformation.

Hexachlorocyclopentadiene (Hex) is an intermediate in the synthesis of cyclodiene insecticides and other industrial chemicals. Environmental contamination with Hex and its by-products and end-products (which contain about 1% Hex) during and after the manufacture of end-products may be possible. Hex underwent chemical alterations in water, forming both lipophilic and hydrophilic products. Its half-life in goldfish of about nine days, which was less than that of cyclodienes, was due to its rapid degradation. The lipophilic nonpolar products in fish were extremely volatile. Three days after the intraperitoneal injection of C-14 labeled Hex, ethyl acetate-extractable radioactivity was approximately 47% while water-solubles and unextractables were 11 and 20% of the injected radioactivity, respectively. The remaining radioactivity was eliminated in the water. About 97% of the injected radioactivity was accounted for. Ethyl acetate extracts of fish included at least eight unidentified breakdown products. Water-solubles from fish and from exposure water included at least 4 and 11 unidentified products, respectively. The studies of the biotransformation of Hex in goldfish are complicated by the fact that Hex and its metabolites are very reactive, many being very volatile and extremely lipophilic. (Moore-IVI)
W85-02214

GROUND WATER QUALITY IN THE AQUIFER OF THE UPPER MAD RIVER VALLEY 1940 TO 1983,
J. D. Pennino.
Ground Water Monitoring Review, Vol. 4, No. 3, p 27-38, 1984. 12 Fig, 3 Tab, 6 Ref.

Descriptors: *Mad River Valley, *Ohio, *Ground water, *Water quality, Dissolved solids, *Sulfates, Fluorides, Calcium, Magnesium, Potassium, Chloride, Sodium, Iron, Zinc, Arsenic, Barium, Lead, Water pollution sources.

More than 40 years of ground quality monitoring data from the aquifer of the Upper Mad River Valley have been accumulated by various agencies in Ohio. The data consists of concentrations for more than 30 chemical substances found in the ground water. Evaluation of this data using statistical analysis, tables and graphs indicates that there have been moderate increases in total dissolved solids, sulfate, fluoride, calcium, magnesium and potassium. More significant increases were discovered for chloride and sodium. Iron and zinc show a general decline in concentration. The metals arsenic, barium and lead also show increases in recent years. However, large variations in the concentrations and limited data for these metals limit the reliability of the apparent trends shown in the tabulated data. The increases in chloride and sodium are attributed to the use of road de-icing salt. Increases in sulfate and potassium may be due to use of fertilizers in a region which is largely agricultural. The most recent data may indicate that the ground water quality is improving in terms of these two parameters. Although most of the data indicate increases in concentrations with time, inconsistencies in sampling procedures and difficulties in assessing many factors which affect ground water quality preclude the broad conclusion that urbanization and industrialization have caused regional ground water quality degradation. The inability to interpret much of the data underlies the need for an integrated environmental monitoring program. Such a program should provide a data base for assessing factors such as air and river quality and historical land use practices so that their impact on ground water quality in the Mad River Valley can be better understood. (Author's abstract)
W85-02216

TRANSPORT OF CARBON, NITROGEN, PHOSPHORUS, AND MAJOR SOLUTES IN THE GAMBIA RIVER, WEST AFRICA,
California Univ., Santa Barbara. Dept. of Biological Sciences.
For primary bibliographic entry see Field 2H.
W85-02220

EFFECTS OF FEEDING RATES ON PRODUCTION OF COMMON CARP AND WATER QUALITY IN PADDY-CUM-FISH CULTURE,
Indian Council of Agricultural Research, New Delhi.
S. K. Ghosh, B. H. Mandal, and D. N. Borthakur.
Aquaculture, Vol. 40, No. 2, p 97-101, July, 1984. 1 Fig, 2 Tab, 6 Ref.

Descriptors: *Fish farming, *Water quality, *Feeding rates, Economic aspects, Carp, Rice paddies, Growth, Water pollution sources.

A 90 day study was conducted of the effects of artificial feeding on production of common carp and on water quality in paddy-cum-fish culture. An increasing trend in the growth of individual fish and fish yield with increasing feeding rates was noted. Concentrations of nitrite, nitrate, chemical oxygen demand, and particulate organic matter also increased with increasing feeding rates. The concentration of dissolved oxygen decreased. A low pond conversion value is indicative of efficient utilization of high quality feed, while a high pond conversion value indicates poor feed quality and low utilization. Pond conversion factors for the present study were calculated and it was determined that a feeding rate of 8.8% of the total body weights of the fish, calculated on the Mitscherlich model would be ideal for economic reasons. A feeding rate beyond 4% was wasteful, and accumulation of the feed caused deterioration in water quality. (Baker-IVI)
W85-02236

SEWAGE SLUDGE FOR CULTIVATING FRESHWATER ALGAE AND THE FATE OF HEAVY METAL AT HIGHER TROPHIC ORGANISMS; IV. HEAVY METAL CONTENTS IN DIFFERENT TROPHIC LEVELS,
Chinese Univ. of Hong Kong, Shatin. Dept. of Biology.
For primary bibliographic entry see Field 5E.
W85-02237

TWO-DIMENSIONAL TIME-DEPENDENT SIMULATION OF CONTAMINANT TRANSPORT FROM A LANDFILL,
Miami Univ., Coral Gables, FL. Coll. of Engineering.
For primary bibliographic entry see Field 5G.
W85-02272

WATER QUALITY PREDICTION IN MIXING ZONES OF RIVERS,
Gore and Storrie Ltd., Toronto (Ontario). Water Resources Div.
T. P. H. Gowda.
Journal of Environmental Engineering, Vol. 110, No. 4, p 751-769, August, 1984. 9 Fig, 3 Tab, 32 Ref.

Descriptors: *Mixing zones, *Mixing zone models, *Water quality, *Stream tube models, Decay rates, Chlorine, Wastewater outfall, Ontario, Path of pollutants.

Steady state models based on the stream tube concept are presented to predict far-field concentration distributions of pollutants in mixing zones of rivers. Analytical solutions for pipe and diffuser outfall sources, presented by N. Yotsukura and E. D. Cobb (1972, U. S. Geological Survey Professional Paper 582-C, USGPO, Washington, D. C., 19pp), are modified to account for the reach-dependency of pollutant decay rate, transverse diffusion factor and channel hydraulic parameters. The models are validated using field data for a conservative tracer (chloride ion) and a nonconservative pollutant (total residual chlorine) collected in shallow rivers located in Southern Ontario, Canada. In general, the models presented in this paper are applicable to conservative and exponentially decaying pollutants. (Author's abstract)
W85-02275

MOISTURE TRANSPORT IN A SOLID WASTE COLUMN,
Stevens Inst. of Tech., Hoboken, NJ. Dept. of Ocean Engineering.
G. P. Korfiatis, A. C. Demetracopoulos, E. L. Bourodimos, and E. G. Nawy.
Journal of Environmental Engineering, Vol. 110, No. 4, p 780-796, August, 1984. 9 Fig, 1 Tab, 36 Ref.

Descriptors: *Solid waste disposal, *Fluid flow, *Unsaturated flow, Mathematical models, Leachate, Landfills, Sanitary landfills.

The physical processes governing moisture transport in solid waste landfills are analyzed by the theory of unsaturated flow through homogeneous porous media and experimental work. A laboratory column was constructed and monitored to determine the behavior of unsaturated flow through solid wastes. The hydraulic properties of the refuse were determined from small scale experiments. A mathematical model was formulated and the experimental results were used to calibrate and verify it. Comparisons of measured and computed leachate discharges showed reasonable agreement. The theory of unsaturated flow through homogeneous porous media was successfully used to model moisture transport through the refuse material of a laboratory column. (Author's abstract)
W85-02276

ACCURATE MODELING OF RIVER POLLUTANT TRANSPORT,
Ministry of Works and Development, Hamilton (New Zealand). Water and Soil Science Centre.
G. B. McBride, and J. C. Rutherford.
Journal of Environmental Engineering, Vol. 110, No. 4, p 808-827, August, 1984. 10 Fig, 31 Ref.

Descriptors: *Waipa River, *New Zealand, *Path of pollutants, Model studies, Dissolved oxygen, Biochemical oxygen demand, River flow.

A simple, accurate, Lagrangian numerical scheme is developed for modeling the advection and dispersion of an nonconservative pollutant in one-dimensional, nonuniform river flow. The scheme is free from the common propensity to produce false oscillations and smearing in steep front regions. Testing of the scheme demonstrates its high accuracy, which is maintained on very coarse grids. A successful application is demonstrated in which it has been used to model the passage of patches of anoxic water down the Waipa River, New Zealand. Longitudinal dispersion coefficients were inferred by matching model predictions to observed steep fronts of DO and BOD5. These were confirmed by subsequent dye studies. River reaeration and deoxygenation coefficients were also inferred, these being useful for managament oriented simulation in this river and elsewhere. (Author's abstract)
W85-02277

CHLORINATED HYDROCARBONS IN THE SEAWATER AND SURFACE SEDIMENTS OF BLANCA BAY, ARGENTINA,
Instituto Argentino de Oceanografia, Buenos Aires. Lab. de Quimica Marina.
J. L. Sericano, and A. E. Pucci.
Estuarine, Coastal and Shelf Science, Vol. 19, No. 1, p 27-51, July, 1984. 3 Fig, 12 Tab, 40 Ref.

Descriptors: *Fate of pollutants, *Chlorinated hydrocarbons, *Pesticides, *Seawater, *Sediments, BHC, Lindane, Heptachlor, Aldrin, DDT, Heptachlor epoxide, Water pollution sources, Particulates.

Of the eleven organochlorine pesticides searched for, 7 could be detected in seawater: alpha-BHC, lindane, heptachlor, delta-BHC, aldrin, o-p'-DDT, and p-p'-DDT, and only 3 in surface sediments: alpha-BHC, lindane, and heptachlor. Dieldrin, heptachlor epoxide, o-p'-DDD and p-p'-DDD concentrations were all below detection limits. The major areas of concentration for the compounds in seawater were in the inner portion of the study area. The highest concentrations in both seawater and sediments were found at a particular site due to the influence of the emptying of the main sewer of Bahia Blanca. The air-sea interface water layer had 18 times more organochlorine compounds than did water from the bottom layer. A study of the correlation between chlorinated hydrocarbon content and particulate matter present in seawater showed that lindane, heptachlor and delta-BHC mean concentrations decreased in those samples containing little particulate matter whereas alpha-BHC and aldrin presented no important changes. No significant correlation was noted between organochlorine levels and the amount of particulate organic material in seawater samples. (Baker-IVI)
W85-02289

WATER QUALITY STUDIES AROUND THE SEWAGE SLUDGE DUMPING SITE IN LIVERPOOL BAY,
Ministry of Agriculture, Fisheries and Food, Burnham on Crouch (England). Fisheries Lab.
M. G. Norton, P. G. W. Jones, A. Franklin, and S. M. Rowlatt.
Estuarine, Coastal and Shelf Science, Vol. 19, No. 1, p 53-67, July, 1984. 6 Fig, 5 Tab, 27 Ref.

Descriptors: *Liverpool Bay, *England, *Water quality, *Sludge disposal, *Mersey River, Spoil disposal, Industrial wastes, Zinc, Copper, Cadmium, Nickel, Fate of pollutants.

Liverpool Bay (England) receives effluents from several sources including direct discharges via coastal outfalls and the rivers Mersey and Dee which carry sewage and industrial discharges; in addition, substantial quantities of sewage sludge and some industrial wastes are dumped at a site about 30 km off the Mersey, and dredged spoils from the maintenance of the Mersey channels and docks are dumped primarily at site 'Z' which is between the river mouth and the sludge dump site. Concentrations of zinc, copper, cadmium and nickel were measured in solution and in suspension at a series of stations from the mouth of the River Mersey to seaward of the sewage sludge dumping ground during two studies in 1978 and 1979. Dissolved metal concentrations were found to be well correlated with salinity and no significant elevations due to dumping were apparent. Particulate metal concentrations, on the other hand, were found to be substantially elevated near the dumping ground in 1979. The effect on the concentrations of suspended particulate metal at the site was short-lived - less than a few days. (Collier-IVI)
W85-02290

SEWAGE SLUDGE DUMPING AND CONTAMINATION OF LIVERPOOL BAY SEDIMENTS,
Ministry of Agriculture, Fisheries and Food, Burnham on Crouch (England). Aquatic Environment Protection Div. II.
M. G. Norton, S. M. Rowlatt, and R. S. Nunny.
Estuarine, Coastal and Shelf Science, Vol. 19, No. 1, p 69-87, July, 1984. 14 Fig, 2 Tab, 24 Ref.

Descriptors: *Liverpool Bay, *England, *Sediments, *Sludge disposal, Organic carbon, Mercury, Cadmium, Copper, Zinc, Lead, Nickel, Chromium, Fate of pollutants.

The results of four Ministry of Agriculture, Fisheries, and Flood surveys (1975-1980) of the sediments in and around the sewage sludge dumping site in Liverpool Bay are presented. Sediments were analyzed for particle size distribution, organic carbon concentrations and concentrations of Hg, Cd, Cu, Zn, Pb, Ni and Cr. Concentrations of organic carbon and metals were found to be elevated in the fine (< 90 micro m) fraction in areas associated with the major inputs of these substances to the bay-near the mouth of the Mersey, near the sewage sludge dumping site and at the dredged spoil dumping site. In an attempt to determine any temporal trends between surveys, stations were grouped into four 8 x 8 km areas from offshore of the dumping ground to the mouth of the Mersey. Change in the metal concentrations in sediments in the square nearest the sewage sludge dumping site were larger than in the other squares including that nearest the Mersey. Comparison of temporal trends near the sewage sludge site with the quantities actually dumped showed a correlation between the two, consistent with sewage sludge dumping being a major contributor to the metal levels in fine sediments near the dumping ground. (Author's abstract)
W85-02291

BEHAVIOUR OF PB, ZN, NI, AND CU IN THE SEDIMENTS OF THE LOUKKOS ESTUARY AND THE CLOSE SHELF (ATLANTIC COAST OF MORROCO) (COMPORTEMENT DU PB, ZN, NI, ET CU DANS LES SEDIMENTS DE L'ESTUAIRE DU LOUKKOS ET DU PROCHE PLATEAU CONTINENTAL (COTE ATLANTIQUE MAROCAINE)),

Institut de Geologie du Bassin d'Aquitaine, Talence (France).
M. Snoussi.
Bulletin de l'Institute de Geologie du Bassin d'Aquitaine, Bordeaux, Vol. 35, p 23-30, 1984. 4 Fig, 8 Ref.

Descriptors: *Loukkos Estuary, *Close Shelf, *Morroco, *Lead, *Zinc, *Nickel, *Copper, *Sediments, Fate of pollutants, Organic carbon, Iron, Estuarine environment.

The primary objective of this work is to study the behavior of some heavy metals (Pb, Zn, Ni and Cu) within the Loukkos estuary and the adjacent littoral prism. Metallic element concentrations in the bulk sediment do not appear to vary systematically from the oued region to the ocean. Conversely, normalization of global content within the < 2 micro m grain-size fraction with organic carbon or iron, reveals the lithologic contribution to the distribution of Pb and also the other metal anomalies, namely at the inlet and off the Loukkos estuary. The abnormally high metallic contents recorded could be related to the physico-chemical processes commonly reported at inlet zones. They could also be encountered in the Larache agglomeration and in industrial plants associated with port activities, south of the estuary inlet. (Author's abstract)
W85-02293

PETROWATCH: PETROLEUM HYDROCARBONS, SYNTHETIC ORGANIC COMPOUNDS, AND HEAVY METALS IN MUSSELS FROM THE MONTEREY BAY AREA OF CENTRAL CALIFORNIA,
California State Dept. of Fish and Game, Monterey. Marine Pollution Studies Lab.
M. Martin, and W. Castle.
Marine Pollution Bulletin, Vol. 15, No. 7, p 259-266, 1984. 4 Fig, 4 Tab, 21 Ref. NOAA Office of Zone Management grant NA 81 AAHCZ 162.

Descriptors: *Monterey Bay, *California, *Hydrocarbons, *Organic compounds, *Heavy metals, *Mussels, Trace metals, Polychlorinated biphenyls, Chlorinated hydrocarbons, Pesticides, Zinc, Lead, Mercury, Bioconcentration, Chlordane, DDT, DDE.

Mussel Watch techniques were used to measure the concentrations of petroleum hydrocarbons, synthetic organic hydrocarbons, and trace metals in a preliminary study of the Monterey Bay area in central California. Resident mussels were found to have higher-than-expected petroleum hydrocarbon body burdens in Carmel Bay, an area thought to be relatively contaminant free. A 'hot spot' of PCB 1254 and pp DDE was measured at Ano Nueuvo Island, a site previously recognized because of elevated levels of mercury in mussels. PCB 1254 concentrations at Ano Nueuvo Island were high in relation to the remainder of coastal United States and Baja California, reflecting entrainment of this compound at a biologically active area. The Monterey Harbor Jetty location showed the highest contamination levels for zinc and lead. In fact, this location has the second highest lead concentrations in mussels for the California coast. Biological cycling of certain compounds (PCB, DDT and mercury) in remote locations such as Ano Nuevo Island, is hypothesized as a mechanism for these elevated concentrations in mussels. Levels of other synthetic organic hydrocarbons were generally low, with chlordanes showing higher concentrations in the more urbanized locations of the study area, i.e. the Monterey Harbor Jetty. (Author's abstract)
W85-02326

CHEMICAL CONTENT OF SNOW AND EFFECT OF MELTING ON CASCADE MOUNTAIN LAKES,
Washington Univ., Seattle. Dept. of Civil Engineering.
E. B. Welch, W. H. Chamberlain, and D. E. Spyridakis.
Northwest Science, Vol. 58, No. 2, p 85-93, May, 1984. 3 Fig, 2 Tab, 15 Ref.

Descriptors: *Cascade Mountains, *Washington, *Snow, *Copper Lake, *Big Heart Lake, *Angeline Lake, Chemical composition, Melting, Sulfates, Nitrates, Hydrogen ion concentration, Alkalinity, Chemistry of precipitation, Conductance, Stratification, Mixing.

Washington's Cascade Mountain lakes have been classified as some of the most sensitive waters in the United States. Their low buffering capacity is due to the granitic and basaltic bedrock and thin soil development surrounding many of these high elevation lakes. Sulfate and nitrate content in snow cores collected in the spring of 1982 indicated that deposition of those ions is greater in the Cascade Mountains, downwind from the Seattle-Tacoma urban-industrial area, than in the Olympic Mountains. Subsequent observations on changing chemical content in the waters of Angeline, Big Heart, and Copper Lakes - located in the Alpine Lakes Wilderness area at 1219 to 1555 m elevation - indicated that snowmelt and iceout did not result in episodes of low pH and alkalinity. The minimum pH was 5.8 and neither pH nor alkalinity showed a seasonal trend following iceout, although specific conductance did decrease slightly. The lack of an acidification episode was not surprising because of pH of snow from a site near the studied lakes averaged 5.3. The snow was richer in cations than had been reported earlier in precipitation from the Cascades, even though sulfate concentrations were similar. Chemical stratification was apparent in the surface 20 m layer of the lowest elevation lake (Copper Lake), while the upper 50 m of the highest elevation lake (Angeline Lake) was similar in alkalinity content to that observed in snow. The intermediate elevation lake (Big Heart Lake) showed a slight tendency to stratify in the upper 50 m. These observations suggest that snowmelt does not mix with the whole lake volume in these deep lakes with relatively low watershed:lake surface area ratios and low flushing rates as might be expected in lakes with more extreme characteristics. (Collier-IVI)
W85-02329

SORPTION OF CHLORINATED PHENOLS BY NATURAL SEDIMENTS AND AQUIFER MATERIALS,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
K. Schellenberg, C. Leuenberger, and R. P. Schwarzenbach.
Enivonmental Science and Technology, Vol. 18, No. 9, p 652-657, 1984. 5 Fig, 4 Tab, 20 Ref. Swiss Department of Commerce project COST 64b bis.

Descriptors: *Phenols, *Chlorinated hydrocarbons, *Sediments, *Aquifers, *Sorption, Partition coefficients, Fate of pollutants, Ionic strength, Hydrogen ion concentration.

Laboratory experiments have been conducted to study the sorption of chlorinated phenols by sediments and aquifer materials. It is shown that sorption not only of the nondissociated phenols but also of their conjugate bases (phenolates) can occur. At typical ambient concentrations, sorption equilibrium can be described by the equation S = DC, where S = concentration in the solid phase, D = overall distribution ratio, and C = concentration in the liquid phase. In natural waters of low ionic strength (i.e., I < or = 0.001 M) and pH not exceeding the pK sub a of the phenol by more than one log unit, phenolate sorption can be neglected and the overall distribution coefficient may be expressed by D = (K sub p)Q, where K sub p = partition coefficient of the nonionized phenol and Q = degree of protonation. K sub p may be estimated from the octanol/water partition coefficient of the compound and from the organic carbon content of the sorbent. In the case of tetra- and pentachlorophenol, phenolate sorption usually has to be considered. It is strongly influenced by the organic carbon content of the sorbent and by the ionic strength of the aqueous medium. (Author's abstract)
W85-02344

GAS CHROMATOGRAPHY/MASS SPECTROSCOPY ANALYSIS OF MUTAGENIC EXTRACTS OF AQUEOUS CHLORINATED HUMIC ACID. A COMPARISON OF THE BY-PRODUCTS TO DRINKING WATER CONTAMINANTS,
Health Effects Research Lab., Cincinnati, OH.
W. E. Coleman, J. W. Munch, W. H. Kaylor, R. P. Strelcher, and H. P. Ringhand.
Environmental Science and Technology, Vol. 18, No. 9, p 674-681, 1984. 2 Fig, 4 Tab, 40 Ref.

Descriptors: *Humic acids, *Gas chromatography, *Mass spectroscopy, *Chlorinated hydrocarbons, *Drinking water, *Mutagenicity, Water pollution sources, Chlorination, Water treatment, Bromides, Solvent extraction, Hydrogen ion concentraton, Chromatography, Spectroscopy.

Formation of mutagenic activity as a result of aqueous chlorination of a model humic acid substrate has been previously demonstrated. In the present study, solvent extracts of solution of the chlorinated model substrate, which responded positively in the Ames test, were analyzed by gas chromatography/mass spectroscopy (GC/MS) in an attempt to identify the mutagenic components. Results of GC/MS analyses of methylene chloride, ether, and closed-loop-stripping extracts indicated that trihalo-methanes and haloacetic acids, -acetonitriles, -propanones, -propenals, -propenenitriles, -propenes, -phenols, and -thiophenes were formed by the aqueous chlorination of humic acid at neutral pH. The concentrations of nine of the halogenated byproducts accounted for about one-fourth of the total organic halogen (TOX) content of the aqueous chlorinated humic acid solution. The similarity of mutagenic compounds identified in this study with compounds previously identified in drinking water suggests that the reaction of chlorine with natural aquatic humic material is a likely source of mutagen formation in drinking water. Some data on the production of halogenated compounds from the chlorination of the model humic acid in the presence of bromide (Br-) are also included. (Author's abstract)
W85-02345

POLYCYCLIC AROMATIC HYDROCARBONS IN WASHINGTON COASTAL SEDIMENTS: AN EVALUATION OF ATMOSPHERIC AND RIVERINE ROUTES OF INTRODUCTION,
Washington Univ., Seattle. School of Oceanography.
F. G. Prahl, E. Crecellus, and R. Carpenter.
Environmental Science and Technology, Vol. 18, No. 9, p 687-693, 1984. 3 Fig, 6 Tab, 33 Ref.

Descriptors: *Washington, *Columbia River, *Suspended sediments, *Polycyclic aromatic hydrocarbons, *Air pollution, *Particulate matter, Hydrocarbons, Water pollution sources, Isotope studies, Lead radioisotopes.

Polycyclic aromatic hydrocarbon (PAH) compositions were characterized monthly over a 1-year period in atmospheric particulate material (APM) collected from three locations in western Washington state and riverine suspended particulate material (SPM) collected near the mouth of the Columbia River. PAH mixtures of APM are dominated by compounds of combustion origin, with minor levels of the resin acid-derived PAH retene often present. SPM contained comparable levels of individual combustion PAH, retene, and perylene. Atmospheric and riverine contributions of individual combustion PAH to the Washington coastal environment were estimated from these data and other available information. Comparison of estimates with respective PAH accumulation rates measured in lead-210 dated coastal sediments shows that > 30 % of all combustion PAH, retene, and perylene in these sediments is supplied by SPM discharge from the Columbia River and direct atmospheric input accounts for at most 10 % of the combustion PAH. Atmospherically transportable PAH are removed from the air over land to soils and freshwaters within the river drainage basin, eroded on particles, and discharged into the Washington coastal environment along with other nonatmospherically transportable PAH such as perylene as intrinsic constituents of the Columbia River's suspended sediment load. (Author's abstract)
W85-02346

INCIDENCE AND LEVELS OF 2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN IN LAKE ONTARIO COMMERICAL FISH,
Health and Welfare Canada, Ottawa (Ontario). Health Protection Branch.
J. J. Ryan, P.-Y. Lau, J. C. Pilon, D. Lewis, and H. A. McLeod.
Environmental Science and Technology, Vol. 18, No. 9, p 719-721, 1984. 1 Tab, 12 Ref.

Descriptors: *Dioxins, *Lake Ontario, *Fish, *Fate of pollutants, Catfish, Eel, Smelt, Bass, Crappie, Pumpkinseed, Polychlorinated biphenyls, Chlorinated hydrocarbons, Great Lakes.

Analysis of commerical fish taken in 1980 mostly from one area of Lake Ontario was undertaken to obtain information on the levels and incidence of the contaminant 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD). Sixty-two (62) samples of fish comprising 10 different species were analyzed by using a validated extraction, cleanup, and detection procedure. Seven of the 10 species contained measurable levels of the isomer 2,3,7,8-TCDD, between 2 and 39 parts per trillion (ppt) with five samples above 20 ppt. Channel catfish, American eel, and rainbow smelt had the highest values, and the lowest levels were found in rock bass, black crappie, and pumpkinseed. The presence of high levels of PCB (> 1 ppm) and high lipid content (> 3%) indicated a high probability of dioxin contamination. Comparison of this data with those generated by other laboratories from all the Great Lakes indicated that the larger species of commercial fish such as channel catfish and carp particulary from Lake Ontario and part of Lake Huron have the highest levels and incidence of 2,3,7,8-TCDD. (Author's abstract)
W85-02349

IODOMETHANE AS A POTENTIAL METAL MOBILIZING AGENT IN NATURE,
Cincinnati Univ., OH. Dept. of Chemistry.
J. S. Thayer, G. J. Olson, and F. E. Brinckman.
Enviromental Science and Technology, Vol. 18, No. 9, p 726-729, 1984. 2 Fig, 4 Tab, 27 Ref.

Descriptors: *Baltimore Harbor, *Maryland, *Chesapeake Bay, *Sediments, *Iodomethane, *Trace metals, *Metal sulfides, Gas chromatography, Atomic adsorption spectrometry, Tin, Copper, Lead, Fate of pollutants.

Naturally occuring iodomethane, an ubiquitous biogenic metabolite, might react with metal sulfides present in anoxic sediments or finished metals in human artifacts or aquatic systems, thereby creating volatile or water-soluble derivatives. Sulfur atoms in metal sulfides have a large degree of covalent character and serve as bridges between metal atoms to form large polymeric arrays. Oxidative addition by iodomethane would break such bridges, at sulfur or metal centers, weakening the lattice and eventually allowing the metal to dissolve. Samples from anoxic sediment from Baltimore Harbor were treated with iodomethane; aliquots of the supernatant water were analyzed with purge-and-trap gas chromatography-flame photometric gas chromatography. Appreciable quantities of dimethylstannane and dimethyl sulfide appeared almost immmediately; tetramethyltin and dimethyl disulfide appeared after overnight standing. Similar studies using atomic absorption spectrometry showed that after 24 h iodomethane had caused dissolution of other metals from the Baltimore Harbor sediments. Samples of sediments from less polluted Chesapeake Bay sediments showed little or no CH3I-stimulated Cu or Pb release. There is insufficient evidence to state that iodomethane enhances the overall circulation of metals throughout the environment, the evidence does point to that strong possibility in certain local environmental compartments. (Collier-IVI)
W85-02350

BOUNDARY INTEGRAL SOLUTION TO SEAWATER INTRUSION INTO COASTAL AQUIFERS,
Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering.
For primary bibliographic entry see Field 2F.
W85-02371

SUBSTANCE DISCHARGES IN THE DRAINAGE AREA OF THE LIMINKA BAY,
Joensuu Univ. (Finland). Dept. of Biology.
J. Siira.
Aqua Fennica, Vol. 13, p 8-26, 1983. 8 Fig, 18 Tab, 28 Ref.

Descriptors: *Liminka Bay, *Finland, *Water pollution sources, *Drainage basins, Peat, Forests, Agriculture, Soil type, Population, Fertilizers, Phosphorus, Nitrogen, Color, Electrolytes.

Liminka Bay, located in western Finland, has a drainage basin which is 1394 sq km in area. The drainage basin is 55% peatland, 27% forest, and 18% fields. The discharge of 19 substances was studied at 33 sampling stations in the basin during the years 1974-1976. The following factors contributing to the discharge were analyzed: number of inhabitants and livestock, percentage of cultivated fields, forest and peatland, percentage of forest drainage, quantity of artificial fertilizers applied, grain size of mineral soil, and the organic matter, N, P, K, and Ca contents of the soil. The effects of these factors were determined by correlation and regression analysis. Color correlates negatively with population, agriculture, and mineral soil, and positively with peat soil and forests. The cultivated field percentage is the most important single explanatory factor. It explains 92% of the total electrolyte discharge, 74% of the total nitrogen and 56% of the total phosphorus discharge. The field percentage and the number of inhabitants together have explanatory power of 90% for the total nitrogen, and the number of livestock and the forest percentage explain 77% of the total electrolyte discharge. (Moore-IVI)
W85-02390

FECAL COLIFORM IN THE SALT RIVER RECREATION AREAS OF ARIZONA,
Tonto National Forest, Phoenix, AZ.
D. E. Nelson, and W. R. Hansen.
Journal of Forestry. Vol. 82, No. 9, p 554-555, September, 1984. 2 Fig, 1 Tab, 3 Ref.

Descriptors: *Coliforms, *Recreation facilities, *Tonto National Forest, *Arizona, Salt River, Feces, Monitoring, Swimming, Public health, Bacteria.

Monitoring for fecal coliform bacteria has been carried out at water recreation sites on the Tonto National Forest in Arizona for the past 12 years. Standards which exist are: geometric means of samples must be less than 200 fecal coliform per 100 milliliters of sample water; no more than 10% of the samples in a 30-day period may exceed 400 fecal coliform per 100 ml; and no single sample may exceed 800 fecal coliform per 100 ml. Large fluctuations in fecal coliform populations were found at all sites. Levels vary widely within short distances (200 feet) and short time periods (hours). High fecal coliform counts are usually associated with periods of heavy use. Counts are usually low on the lower Salt River, despite heavy use, probably due to the continuous supply of fresh water from the upstream dam. No correlation was found between water clarity measurements and fecal coliform counts. Coves and bays isolated from lake currents tend to build up higher fecal coliform populations than sites on the main part of the lake. Speciation of bacteria during the summer indicates that they are coming from both human and animal sources. Given the potential for contamination by stormflows, recreation managers may wish to avoid stream inlets when selecting sites for swimming areas. (Baker-IVI)
W85-02394

RECOVERY OF SELECTED PATHOGENS FROM NAPLES BAY, FLORIDA, AND ASSOCIATED WATERWAYS,
University of South Florida, Tampa. Dept. of Biology.
M. E. Peterson, B. J. Yokel, and D. V. Lim.
Estuaries, Vol. 7, No. 2, p 133-138, June, 1984. 3 Tab, 21 Ref.

Descriptors: *Pathogenic bacteria, *Bays, *Naples Bay, *Florida, Salmonella, Coliforms, Monitoring, Public health, Water quality control.

The possible presence of potentially pathogenic bacteria was investigated in Naples Bay, Florida. Specific attention was given to Salmonella, Vibrio cholerae, V. parahaemolyticus, and Pseudomonas aeruginosa. Vibrio cholerae was isolated in 39 of the samples (33.6%) taken from February 17, 1981 to January 5, 1982. All of the V. cholerae isolates were nonagglutinable in 01 type antiserum. V. parahaemolyticus was not recovered from any of the samples. Salmonella was isolated in 33 of 115 samples (28.4%). The numbers of P. aeruginosa were low at all stations sampled in this study except for the months of July and August. V. cholerae was recovered at all sites except one. Water temperatures and salinity were factors which affected the presence of bacteria. The bacteria were recovered from areas with both high and low numbers of total and fecal coliforms. (Baker-IVI)
W85-02397

LEAD HAZARD CONTROLLED IN SCOTTISH WATER SYSTEMS,
Umgeni Water Board, Pietermaritzburg (South Africa).
W. N. Richards, and M. R. Moore.
Journal of the American Water Works Association, Vol. 76, No. 8, p 60-67, August, 1984. 7 Fig, 3 Tab, 34 Ref.

Descriptors: *Lead, *Drinking water, *Scotland, *Orthophosphates, *Hydrogen ion concentration, Water treatment, Pipes, Water storage, Public health, Lime.

In many places in Scotland, drinking water has concentrations of lead far above established limits. This lead enters the drinking water through contact with lead lined pipes. In Glasgow before remedial water treatment, approximately 50% of the water samples randomly taken from houses had a lead content exceeding 100 micro g/L. A fully automatic closed loop lime dosing system was installed at the Milngavie Treatment Works. After the pH of the water was raised from 6.3 to 7.8, 80% of random daytime samples of water leaving the plant contained less than 100 micro g Pb/L. Exceptionally high lead levels were also detected in drinking water for the coastal town of Ayr. A pH of 7 was achieved in spring of 1981 by restricting the output of the Knockjarder Treatment Works and mixing the water with pH-corrected water from another chemically treated supply. The pH was raised to 9.0 a few months later following the installation of an auxiliary lime dosing system. In other parts of Scotland, in spite of raised pH levels, the water samples continued to have elevated lead concentrations either because the water was held for long periods in a series of service reservoirs, causing depressed pH levels, or because of the plumbing configurations of individual dwellings, in particular the storage of water in lead-lined cisterns. Sodium dihydrogen orthophosphate solutions were added to the water to give a nominal orthophosphate concentration of 2 mg P/L. On the average, samples from dwellings so treated contained less than 25% of the lead which had been present before the addition of phosphate. With decreased levels of lead in the drinking water, the levels of lead in the blood of the consumers was also significantly reduced. (Baker-IVI)
W85-02402

NITRATE LEACHING FROM GRASSLAND,
Grasslands Research Inst., Hurley (England).
For primary bibliographic entry see Field 5G.
W85-02404

SEASONAL VARIATION OF ARSENIC CONCENTRATION IN WELL WATER IN LANE COUNTY, OREGON,
Oregon Univ., Eugene. Dept. of Biology.
J. J. Nadakavukaren, R. L. Ingermann, G. Jeddeloh, and S. J. Falkowski.
Bulletin of Environmental Contamination and Toxicology, Vol. 33, No. 3, p 264-269, September, 1984. 4 Fig, 10 Ref. NSF grant EPP 7509541.

Descriptors: *Wells, *Arsenic, *Lane County, *Oregon, Seasonal variation, Groundwater pollution, Water quality.

Fourteen wells in Lane County were used for analysis. The municipal well system of the city of Lowell was chosen for study because of excessive arsenic concentrations found in October of 1974. All of the wells were modern cased types of comparable depth, 20-50 m, and none were near agricultural operations using arsenicals. Arsenic concentrations in water from the wells followed several seasonal patterns. There was no apparent correlation between arsenic concentrations and pH. Rainfall appears to be the major factor influencing the arsenic content in these wells, yet some of these wells also show large excursions and a spring peak that have no obvious relation to rainfall. Rainfall could influence the groundwater arsenic content directly by recharging the aquifer, or indirectly through the water usage rate - if high pumping rates depress the water table in the vicinity of the well, deeper groundwater could enter the aquifer. Well depth may also be a contributing factor. No consistent geochemical or environmental factors could be found to account for these variations. Accurate water quality asessment requires repeated sampling over an extended period. If this is not possible, an optimal season for sampling should be determined locally. In Lane County, arsenic analyses of summer water samples are likely to be more valuable than winter samples in assessing water quality. (Baker-IVI)
W85-02414

CONSTITUENT BIOCONCENTRATION IN RAINBOW TROUT EXPOSED TO A COMPLEX CHEMICAL MIXTURE,
G. Linder, H. L. Bergman, and J. S. Meyer.
Bulletin of Environmental Contamination and Toxicology, Vol. 33, No. 3, p 330-338, September, 1984. 4 Fig, 2 Tab, 12 Ref. NIH grant ES-07073.

Descriptors: *Biological magnification, *Fish, *Organic compounds, Water pollution effects, Oil spills, Oil shale, Fate of pollutants.

Classically, aquatic contaminant fate models predicting a chemical's bioconcentration factor (BCF) are based upon single-compound derived models, yet such BCF predictions may deviate from observed BCFs when physicochemical interactions or biological responses to complex chemical mixture exposures are not adequately considered in the predictive model. Rainbow trout were exposed to oil-shale retort waters. Such a study was designed to model the potential biological effects precluded by exposure to complex chemical mixtures such as solid waste leachates, agricultural runoff, and industrial process waste waters. Chromatographic analyses of aqueous and nonaqueous liquid-liquid reservoir components yielded differences in mixed extraction solvent HPLC profiles of whole fish exposed for 1 and 3 weeks to the highest dilution of the complex chemical mixture when compared to their corresponding control, yet subsequent whole fish extractions at 6, 9, 12, and 15 weeks into exposure demonstrated no qualitative differences between control and exposed fish. Liver extractions and deproteinized bile samples from exposed fish were qualitatively different than their corresponding controls. These findings support the projected NOEC of 0.0045% dilution, even though the differences in bioconcentration profiles suggest hazard assessment strategies may be useful in evaluating environmental fate processes associated with complex chemical mixtures. (Baker-IVI)
W85-02416

ENVIRONMENTAL FATE AND TOXICITY IN WASTEWATER TREATMENT OF QUATERNARY AMMONIUM SURFACTANTS,
Environmental Protection Agency, Washington, DC. Office of Toxic Substances.
R. S. Boethling.
Water Research, Vol. 18, No. 9, p 1061-1076, 1984. 2 Fig, 2 Tab, 80 Ref.

Descriptors: *Biodegradation, *Quaternary ammonium compounds, *Wastewater treatment, *Fate of pollutants, *Reviews, Environmental effects, Water pollution sources, Chemical reactions.

Considerable research has been devoted in recent years to the biodegradation of quaternary ammonium compounds (QACs), both in wastewater treatment and in receiving waters, and to the toxicity of QACs to microbial populations in wastewater treatment systems. Specific topics covered in this review include the analysis of QACs; toxicity of QACs in wastewater treatment; environmental fate of QACs, including fate in wastewater treatment, and fate in receiving waters. A mass of evidence suggests that QAC concentrations in the soluble phase should be reduced by at least 90% in publicly owned treatment works under normal circumstances. Both sorption and biodegradation contribute to QAC removal, but sorption is more rapid, so that biodegradation is expected to occur mainly on sludge solids. Many QACs will undergo ultimate biodegradation in aerobic biological treatment. Whereas toxicity of QACs would obviously be mitigated by any opportunity for acclimation and by the relatively low concentrations in sewage, anionic surfactants will also play a role in reducing toxicity. Anionic surfactants, which should normally be present in sewage at levels much higher than those of QACs form stoichiometric complexes with QACs, and this reaction by itself may reduce or even eliminate toxicity. Results from recent monitoring studies confirm these predictions. (Baker-IVI)
W85-02424

ENVIRONMENTAL FATE OF A DISPERSED EKOFISK CRUDE OIL IN SEA-IMMERSED PLASTIC COLUMNS,
Bergen Univ. (Norway). Dept. of Chemistry.
K. Tjessem, D. Pedersen, and A. Aaberg.
Water Research, Vol. 18, No. 9, p 1129-1136, 1984. 4 Fig, 5 Tab, 23 Ref.

Descriptors: *Oil spills, *Detergents, *Toxicity, *Photochemical reactions, Oxidation, Oil pollution, Marine environments, Cleanup operations.

Particular emphasis is placed on the strong photochemical impacts of this crude oil under field conditions at 60 degrees latitude with the understanding that the oil dispersant-photooxidation interactions may well be a component of much of the observed detergent toxicity effects occurring during cleanup operations after oil spills. Both tritiated and unlabelled Ekofisk crude oil were poured (.5 L each) onto the water surface of two large plastic enclosures north of Bergen, Norway during June 1980. A nonlabelled detergent Corexit 9527 was used to treat the slicks 24 hr after the initial addition of the oil to the water surface. Two replicate ecosystems without the added detergent served as control. A high concentration of polar petroleum derived components exceeding the concentration of petroleum hydrocarbons several times was formed inside the oil/dispersant enclosures which, together with transformation products of the dispersant, proved fairly toxic to several marine biota, virtually eliminating the total planktonic biomass. Photooxidation of the oil/dispersant mixture has been invoked as a primary mechanism to explain the formation of polar substances being leached into the water column. These findings suggest that the dispersed hydrocarbons or the original detergent itself are not likely to be responsible for most of the observed toxicity. The toxicity of the transformation products of the oil and detergent contain many reactive groups and are a much more valid concern. (Baker-IVI)
W85-02431

MODELING SEDIMENT AND WATER COLUMN INTERACTIONS FOR HYDROPHOBIC POLLUTANTS. PARAMETER DISCRIMINATION AND MODEL RESPONSE TO INPUT UNCERTAINTY,
Universidad Simon Bolivar, Caracas (Venezuela). Dept. de Procesos y Sistemas.
P. R. Jaffe, and R. A. Ferrara.
Water Research, Vol. 18, No. 9, p 1169-1174, 1984. 2 Fig, 5 Tab, 8 Ref.

Descriptors: *Lake sediments, *Model studies, *Fate of pollutants, Pesticides, Evaporation rate, Latin hypercube, Pore water, Partition coefficient, Runoff, Chemical reactions, Simulation.

Circumstances were examined under which detailed model descriptions of sediment bed/water column interactions are necessary. Efforts were made to determine which parameters are most critical to the situation and how accurately they must be determined. Model simulations were conducted on a hypothetical sedimentation pond for which typical values were chosen for yearly storm runoff data including runoff volume, sediment mass, and pesticide load. A Latin hypercube sampling scheme for model response analysis to nine model parameters simultaneously was used. Compared to a full factorial design for the same variables and sampling intervals, the Latin hypercube results in a much smaller sample, and consequently a less expensive analysis. The model output is most sensitive to the partition coefficient and the dissolved phase reaction rate coefficient. It is important to have an accurate estimate of the partition and reaction rate coefficients and wherever possible, site-specific values should be determined. For the remaining seven parameters, literature estimates may be used satisfactorily. For compounds with high partition coefficients the interactions between the fractions of the compound contained in the bottom sediments and the water column are significant, while for compounds with low partition coefficients these interactions are not significant. In both cases as long as sorption occurs, removal of the sorbed phase due to sedimentation is still an important process. (Baker-IVI)
W85-02437

SIMULATION OF THE BEHAVIOUR OF NITROGEN IN SOILS (SIMULATION DE L'IMPACT DE PRODUITS REACTIFS DANS LES SOLS - CAS DE L'AZOTE),
Centre National de la Recherche Scientifique, Toulouse (France). Inst. de Mecanique des Fluides.
B. Caussade, and M. Prat.
Journal of Hydrology, Vol. 73, No. 1/2, p 89-104, July, 1984. 9 Fig, 36 Ref.

Descriptors: *Model studies, *Soil water, *Nitrogen, Nitrification, Mineralization, Ion exchange, Ammonium, Soil properties, Unsaturated flow, Simulation, Path of pollutants.

A one-dimensional unsteady-state numerical model is presented to simulate the behavior of nitrogen in soil. The model takes into consideration the various influences of soil-water movement, temperature variations, and plant uptake to simulate nitrogen transport and transformations through a homogeneous soil under unsaturated flow conditions. Transformations which are considered include: nitrification, immobilization, mineralization and ionic exchange of ammonium. The model is solved using a finite difference method, the validity of which is tested by comparing numerical simulation results with field experimental data concerning nitrogen-fertilized wheat growing land. (Baker-IVI)
W85-02460

STUDY AND MANAGEMENT MODEL OF SURFACE-WATER NITROGEN CONCENTRATION IN A CULTIVATED CATCHMENT (MODELE D'ETUDE ET DE GESTION DE LA TENEUR EN AZOTE DES EAUX DE SURFACE DANS UN BASSIN-VERSANT SOUS CULTURE),
Centre National de la Recherche Scientifique, Toulouse (France). Inst. de Mecanique des Fluides.
B. Caussade, D. Pierre, and M. Prat.
Journal of Hydrology, Vol. 73, No. 1/2, p 105-128, July, 1984. 16 Fig, 1 Tab, 25 Ref.

Descriptors: *Nitrogen compounds, *Agricultural chemicals, *Sediment transport, *River basins, Fertilizers, Runoff, Model studies, Transport, Leaching, Temperature effects.

A simulation of nitrogen transformations and transport for river basins with various fertilized crops is presented in a model study. The origin of nitrogen in this study consists of various non-point sources. Nitrogen tranformation and transport toward the river outlet are simulated. Experimental data from a small basin in the southwest of France was used to validate the model. The influence of various phenomena on water quality are demonstrable

using the model including leaching, temperature, fertilizer use and crop types. (Baker-IVI)
W85-02461

BIOACCUMULATION OF HEAVY METALS BY BIVALVES FROM LIM FJORD (NORTH ADRIATIC SEA),
Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Angewandte Physikalische Chemie.
D. Martincic, H. W. Nurnberg, M. Stoeppler, and M. Branica.
Marine Biology, Vol. 81, No. 2, p 177-188, August, 1984. 7 Fig, 1 Tab, 53 Ref.

Descriptors: *Heavy metals, *Bioaccumulation, *Lim Fjord, *Mollusks, *Adriatic Sea, *Fate of pollutants, Oysters, Mussels, Zinc, Lead, Cadmium, Copper.

The accumulation of trace metals (Zn, Cd, Pb and Cu) by two bivalves (Mytilus galloprovincialis and Ostrea edulis) growing at the same station and therefore under the same physicochemical conditions was studied. The oysters were more effective bioaccumulators for zinc, cadmium, lead and copper than the mussels. Oysters accumulate about 10-fold higher quantities of zinc than mussels, 16-fold higher for copper, 3-fold higher cadmium, and 2-fold higher lead concentrations. The observed differences in the copper and zinc distribution within the investigated organs can be attributed to some recently recognized blood cells in the oyster which are rich in zinc and copper. The tissue copper and zinc distribution in this animal depends on where these cells are at the time of sampling. The mussel contains no such cells. (Baker-IVI)
W85-02471

CHRONOLOGY OF LEAD POLLUTION CONTAINED IN BANDED CORAL SKELETONS,
Nova Univ. Oceanographic Center, Dania, FL.
R. E. Dodge, and T. R. Gilbert.
Marine Biology, Vol. 82, No.1, p 9-13, August, 1984. 3 Fig, 1 Tab, 50 Ref. NOAA grant NA80 RAD 00045.

Descriptors: *Lead, *Corals, *St. Croix, *Virgin Islands, Fate of pollutants, Heavy metals, Pollution indicators, Bioindicators.

The possibility of the annual skeletal growth bands of reef-building corals containing a record of lead additions to the marine environment was investigated using coral skeletons from St. Croix, Virgin Islands. Concentrations of lead within a coral from a polluted reef averaged 395 ng/g, five fold higher than within a coral from a pristine site, 87 ng/g. The lead chronologies of both corals showed a significant increase in concentration towards the present during the past 26 yr. The increase in lead concentration in the coral from the pristine site is suggested to represent the increase in lead availability from global pollution. Coral skeletons offer the probability of development into tools for long term chemical recorders of levels of lead and possibly other metals or compounds in seawater. (Baker-IVI)
W85-02472

SEDIMENT-WATER EXCHANGE IN SHALLOW WATER ESTUARINE SEDIMENTS,
Washington Univ., Seattle. School of Oceanography.
S. Emerson, R. Jahnke, and D. Heggie.
Journal of Marine Research, Vol. 42, No. 3, p 709-730, May, 1984. 7 Fig, 4 Tab, 40 Ref.

Descripors: *Puget Sound, *Interstitial water, *Estuarine environment, *Fate of pollutants, *Sediments, Shallow water, Metals, Sediment-water interfaces.

Most reactive inorganic and organic pollutants that are introduced to the environment will, at some point in their journey to the sea, be buried or recycled within estuaries. Processes at the estuarine sediment-water interface play an important role in determining the ultimate fate of these substances. Pore water distributions are described in Quartermaster Harbor, Puget Sound over the period of 1976-1979 along with an in situ tracer experiment designed to monitor the transport of water across the sediment-water interface. Transport processes in sediment pore waters of the Sound were dominated by molecular diffusion in the top few centimeters with animal activity being the most important transport process below this to 20-70 cm. The value of the transport parameter for the nonlocal process is 1 to 5 to the minus 7th power/second. Using this value and pore water concentrations it can be demonstrated that animal activities are the dominant process driving sediment-water dissolved fluxes except for elements with dramatic bottom water-pore water concentration gradients. For the metals Fe, Mn, Cu, Ni and Cd the dominant transport mechanism depends on the depth at which the metal is released to the pore waters. Probably the most important effect of biological activity on metal remobilization is the removal of sulfide from the pore waters, via ventilation of sediments with oxic overlying water, allowing the enrichment of dissolved metals which might otherwise be very low in concentration due to insoluble sulfide formation. The result is a greatly enhanced flux of metals to the bottom waters. (Baker-IVI)
W85-02473

NONEQUILIBRIUM AND EQUILIBRIUM SORPTION WITH A LINEAR SORPTION ISOTHERM DURING MASS TRANSPORT THROUGH AN INFINITE POROUS MEDIUM: SOME ANALYTICAL SOLUTIONS,
California Univ., Berkeley. Lawrence Berkeley Lab.
For primary bibliographic entry see Field 2F.
W85-02488

DETERMINATION OF THE TROPHIC STATE OF LAKE TRASIMENO BY INDIRECT ANALYSIS OF NITROGEN AND PHOSPHORUS (DETERMINAZIONE DELLO STATO TROFICO DEL LAGO TRASIMENO ATTRAVERSO LA VALUTAZIONE INDIRETTA DELL'AZOTO E DEL FOSFORO),
Perugia Univ. (Italy). Ist. di Idrobiologia e Pescicultura.
For primary bibliographic entry see Field 5C.
W85-02497

TOTAL PHOSPHORUS LOAD TO LAKE MONATE (NORTHERN ITALY, VARESE) (STIMA DEL CARICO DI FOSFORO TOTALE AL LAGO DI MONATE (PROVINCIA DI VARESE, ITALIA SETTENTRIONALE)),
Commission of the European Communities, Ispra (Italy).
D. Annoni, and O. Ravera.
Rivista di Idrobiologia, Vol. 20, No. 3, p 699-708, 1981. 3 Fig, 4 Tab, 12 Ref.

Descriptors: *Phosphorus, *Lake Monate, *Italy, Water pollution sources, Eutrophication, Mesotrophic lakes.

Total phosphorus load entering Lake Monate, Italy was calculated considering the distance between the sources of phosphorus (e.g. inhabitants, tourists, hotels, restaurants) and the lake. According to Vollenweider's model fed with the data obtained, Lake Monate at present is mesotrophic, whereas the data collected from 1969-1971 indicate that the same lake was oligotrophic. Some hypotheses concerning the increase of trophy of the lake are discussed. (Author's abstract)
W85-02501

CHEMICAL AND PHYSICAL CHARACTERISTICS OF THE WATERS OF THE ADIGE RIVER AND ITS GREATEST TRIBUTARIES, RUNNING THROUGH THE VERONA'S AREA (INDAGINE PRELIMINARE SULLE CARATTERISTICHE FISICHE E CHIMICHE DEL TRATTO VERONESE DELL'ADIGE E DEI SUOI AFFLUENTI A REGIME PERENNE),
Padua Univ. (Italy). Ist. di Biologia Animale.
B. Duzzin.
Rivista di Idrobiologia, Vol. 20, No. 3, p 709-730, 1981. 4 Fig, 3 Tab, 15 Ref.

Descriptors: *Adige River, Chiampo River, *Verona, *Italy, *Water pollution, River flow, Anoxic conditions, Fate of pollutants.

Samples have been taken from fourteen stations in the period comprised between July 1980 and July 1981. The results show the gradual worsening of conditions of the river waters upstream of Verona, the high pollution levels in the immediate proximity after the city, a considerable lowering of pollution in the following tract owing to artificial canal waters flowing into the river. A remarkable observation from the data is that the Adige river autodepuration capacity in the last tract (30 km) appears to be completely lacking. The flow condition is essential to determine the general characteristics of the river water quality. Among the Adige tributaries the Chiampo river is the most polluted: in its waters completely anoxic conditions have been sometimes observed. (Author's abstract)
W85-02502

PRELIMINARY ESTIMATE OF NUTRIENT RUN-OFF INTO TWO LAKES IN THE LECZYNSKO-WLODAWSKIE LAKE DISTRICT THROUGHOUT A YEAR,
Akademia Rolnicza, Lublin (Poland). Inst. of Soil Science and Agricultural Chemistry.
H. Smal, and M. Misztal.
Acta Hydrobiologica, Vol. 24, No. 3, p 187-196, 1982. 1 Fig, 4 Tab, 8 Ref.

Descriptors: *Runoff, *Nitrates, *Water pollution sources, *Poland, *Lakes, *Leczynsko-Wlodawskie Lake, Agricultural chemicals, Nutrients.

The investigation of nutrient run-off to water bodies is of great interest in view of the progressive deterioration of water quality due to pollution, poisoning, and eutrophication. Such an investigation was started in the Leczynsko-Wlodawskie Lake District where agriculture in the region has been intensified and a rapid development has been noted in tourism. During the year of study the concentration of elements and their forms in water greatly varied in the different sectors of the Lake Piaseczno catchment. In the catchment of Lake Bialka greater differences appeared in the case of sodium and magnesium ions. The highest concentration of nitrates was found in the ground waters of the agricultural sector of Lake Piaseczno catchment. (Baker-IVI)
W85-02508

STREAM ECOSYSTEMS IN MOUNTAIN GRASSLAND (WEST CARPATHIANS); 3. CHEMICAL COMPOSITION OF WATER,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
For primary bibliographic entry see Field 2K.
W85-02514

STREAM ECOSYSTEMS IN MOUNTAIN GRASSLAND (WEST CARPATHIANS); 4. HEAVY METALS,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
M. Reczynska-Dutka.
Acta Hydrobiologica, Vol. 24, No. 4, p 337-341, 1982. 2 Tab, 16 Ref.

Descriptors: *Water pollution sources, *Land use, *Heavy metals, *West Carpathians, *Poland, Fertilizers, Grazing, Zinc, Air pollution.

The level of heavy metals was determined in the water of the Biala Woda and Kamionka streams against the background of the natural conditions in their basins and the pastoral management of this territory. The level of heavy metals approximated that characteristic for natural waters. However, intensified use of the basins for sheep grazing and mineral fertilization was manifested by an increased zinc content in the water. The variation in the concentrations of some metals may also be connected with pollution introduced by means of atmospheric precipitation. (Baker-IVI)
W85-02515

STREAM ECOSYSTEMS IN MOUNTAIN GRASSLAND (WEST CARPATHIANS); 5. BACTERIA,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
A. Starzecka, and K. Trela.
Acta Hydrobiologica, Vol. 24, No. 4, p 343-355, 1982. 4 Fig, 10 Ref.

Descriptors: *Bacteria, *Water quality, *Land use, *West Carpathians, *Poland, Water pollution sources, Seasonal variation, Pastures.

A bacteriological characterization was made of the headwaters of the Grajcarek stream (the streams Czarna Woda, Biala Woda, Kamionka and Grajcarek) The effect of traditional and intense pastoral systems on water purity and seasonal changes in the numbers of bacteria were determined. The most uniform number of total heterotrophic bacteria was found in the water of the midforest stream Czarna Woda. In other streams the number of heterotrophs increased distinctly in the summer and early autumn periods. A tendency to increasing pollution is noted in more intensely used areas. (Baker-IVI)
W85-02516

STREAM ECOSYSTEMS IN MOUNTAIN GRASSLAND (WEST CARPATHIANS); 6. SESSILE ALGAE COMMUNITIES,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
B. Kawecka.
Acta Hydrobiologica, Vol. 24, No. 4, p 357-365, 1982. 2 Tab, 13 Ref.

Descriptors: *Grasslands, *Algal growth, *Population dynamics, *Land use, *West Carpathians, *Poland, Grazing, Fertilization, Farming.

The structure of algal communities developing in the mountain streams flowing through grassland was investigated and their growth during the year was observed. While there were similarities between the algal communities in control streams in a wooded drainage area and in streams situated in the regions of pastures with traditional and intensive fertilization, the size of the populations of some of the species present was significantly different. The index of diatom biomass reached the highest values in the stream flowing across the regions of pastures used for traditional sheep grazing, and the lowest ones in the area of the experimental pastures undergoing intensive fertilization. (Baker-IVI)
W85-02517

STREAM ECOSYSTEMS IN MOUNTAIN GRASSLAND (WEST CARPATHIANS); 9. OLIGOCHAETA,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
E. Dumnicka.
Acta Hydrobiologica, Vol. 24, No. 4, p 391-398, 1982. 1 Fig, 1 Tab, 13 Ref.

Descriptors: *Land use, *Grasslands, *West Carpathians, *Poland, *Oligochaetes, Annelids, Grazing, Minerals, Population dynamics, Eutrophication.

The composition of oligochaetes communities in mountain streams of the upper Grajcarek catchment basin was investigated in areas of different intensity of pastoral land use. Moreover, the comparison of the composition and structure of Oligochaeta communities in the investigated streams was made with those in other mountain streams. Twenty-two species belonging to 5 families were found in the streams. In the Biala Woda stream the characteristic communities of mountain streams were noted. The species of the genus Nais predominated while Enchytraeidae were also fairly numerous. Apart from species typical for mountain streams, those typical for lowland or slightly polluted waters were also encountered in the Kamionka stream, suggesting the eutrophication of the water due to pasturing. (Baker-IVI)
W85-02520

STREAM ECOSYSTEMS IN MOUNTAIN GRASSLAND (WEST CARPATHIANS); 12. GENERAL CONCLUSION,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
A. Kownacki.
Acta Hydrobiologica, Vol. 24, No. 4, p 413-422, 1982. 1 Fig, 11 Ref.

Descriptors: *Land use, *Streams, *Grazing, *West Carpathians, *Poland, Forests, Pastures, Nutrients, Benthic environment, Ecosystems.

The effect on stream ecosystems of pastoral economy in West Carpathran mountainous areas was investigated. Signs of any transformation of the biocenosis under the influence of this use of the land were sought, including hydrological investigations, hydrochemical, bacteriological, algological, and faunistic changes. The investigations were carried out at three stations: BW1, the control, not affected by pasturing, established in the upper sector of the Biala Woda stream at an altitude of 690 m was located at the outskirts of a large forest complex. BW2 was located in the Biala Woda stream at 640 m in an area of traditional pastures. K2 was located in the Kamionka stream at 690 m in the areas of experimental pastures. The aim was to determine whether stations lying at similar altitudes in the same ecological zone would reflect differences caused solely by the character of land use surrounding them. The first signs of impairment of self-regulation mechanisms in these ecosystems were noted. Differences were reported in the number of individual groups of organisms and in the structure of biocenoses, and disturbances in the seasonal fluctuations of numbers and structures of the communities were found. The changes in natural stream biocenoses were caused not only by increasing the amount of nutrients washed out from the meadows, but also by such physical factors as differences in water discharge, insulation and temperature. (Baker-IVI)
W85-02521

QUANTITATIVE INVESTIGATIONS ON ODONATA, HETEROPTERA AND COLEOPTERA IN A DRAINAGE CHANNEL NEAR THE VILLAGE OF TUREW (POZNAN REGION),
Polish Academy of Sciences, Poznan. Dept. of Agrobiology and Forestry.
S. Mielewczyk.
Acta Hydrobiologica, Vol. 25/26, No. 1, p 89-100, 1983/1984. 2 Fig, 3 Tab, 14 Ref.

Descriptors: *Drainage canals, *Land use, *Insects, *Turew, *Poland, Population dynamics, Water quality, Meadows, Forests, Aquatic fauna.

Within the framework of complex investigations a quantitative study was made of the fauna in a drainage channel near Turew, which is typical of the agricultural lands of the Poznan region. The investigation attempted to evaluate the energy flow and cycling of matter in various ecosystems of the agricultural landscape. The dominant structure and changes in the density and biomass of Odonata, Heteroptera, and Coleoptera in the vegetative season from May to September are described for two sectors of the channel, one flowing through meadows and the other through woods, across the agricultural land. In the meadow sector the fauna of these insects was qualitatively and quantitatively richer than in the wooded area. (Baker-IVI)
W85-02523

EFFECT OF DISCHARGE RATE ON BIOTIC AND ABIOTIC CHEMICAL FLUX IN AN ACIDIFIED STREAM,
Ontario Ministry of the Environment, Toronto.
R. J. Hall, and G. E. Likens.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 41, No. 8, p 1132-1138, August, 1984. 4 Tab, 51 Ref.

Descriptors: *Acidification, *Water pollution effects, *Flow discharge, Path of pollutants, Norris Brook, New Hampshire, Aluminum, Calcium, Magnesium, Potassium, Sodium, Nitrates, Organic carbon, Fluctuations, Invertebrates, Storms.

Acidity of Norris Brook, a mountain stream in the Hubbard Brook Experimental Forest, New Hampshire, was manipulated to estimate the effects on biotic and abiotic chemical flux during high (spring) and low (summer) discharge periods. Sulfuric acid was added to maintain the pH near 4.0 from April to September 1977. Al, Ca, Mg, and K were mobilized into streamwater with concentrations progessively increasing downstream, as a result of increased H(+) concentration. Concentrations of Na and NO3 were not affected by the acidification. Dissolved organic carbon concentrations decreased downstream during periods of high discharge but did not change significantly during low flow. During storms, Al, Ca, Mg, and K increased in concentration below the acid addition as well as in the reference reach of the stream. Net flux of dissolved Al in streamwater was significant during both high- and low-discharge periods. Net flux of Al in invertebrate biomass was significantly increased only during high flow but was insignificant when compared with the amount in the dissolved form. Net flux of N was significant only in biomass of invertebrates at high discharge. Significance of flux on N in biota was totally overshadowed by transport (flux) of dissolved N (as NO3 and NH4) during storms. (Author's abstract)
W85-02534

ULTRASTRUCTURAL LOCALIZATION OF METALS IN SPECIMENS OF LITTORINA LITTOREA COLLECTED FROM CLEAN AND POLLUTED SITES,
Reading Univ. (England). Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W85-02543

MUTAGENIC ACTIVITY OF RUNOFF AND LEACHATE WATER FROM HAZARDOUS WASTE LAND TREATMENT,
Texas A and M Univ., College Station. Dept. of Soil and Crop Sciences.
K. W. Brown, and K. C. Donnelly.
Environmental Pollution (Series A), Vol. 35, No. 3, p 229-246, 1984. 2 Fig, 6 Tab, 25 Ref. EPA grant R.805474010.

Descriptors: *Mutagens, *Hazardous wastes, *Land disposal, *Leachates, Sludge, Runoff, Water pollution sources, Oil industry, Industrial wastes, Bioassay.

The mutagenic potential of runoff and leachate water from petroleum sludge-amended soils was determined using the Salmonella microsome assay and the Bacillus subtilis DNA repair assay. The runoff and leachate samples were collected from four different soils amended with an API-separator sludge from either a petroleum refinery or a petrochemical plant. While mutagenic activity was detected in limited number of runoff and leachate samples, greater amounts of mutagenic activity were detected in the runoff water. The majority of samples which were toxic to Salmonella at low dose levels induced increased lethal damage to DNA repair-deficient strains of B. subtilis. Generally, the mutagenic activity of leachate water and the runoff water from two of the three soils decreased with time following waste application. The activity in the third soil did not decrease over the 3 years of observation. The amounts of activity released from the soil in the leachate and runoff water were small compared with other environmetal exposures, indicating that while land treatment may allow some release to the environment, the impact is likely to be small. The results also indicate that microbial bioassays may prove to be a useful tool environmental monitoring of land treatment facilities. (Author's abstract)
W85-02588

ROLE OF RESISTANCE TO STARVATION IN BACTERIAL SURVIVAL IN SEWAGE AND LAKE WATER,
Cornell Univ., Ithaca, NY. Lab. of Soil Microbiology.
J. L. Sinclair, and M. Alexander.
Applied and Environmental Microbiology, Vol. 48, No. 2, p 410-415, August, 1984. 4 Fig, 1 Tab, 17 Ref. EPA R807688020.

Descriptors: *Bacteria, *Starvation, *Wastewater, *Lake water, Nutrients, Competition, Bacterial survival.

A study was conducted to determine the significance of starvation resistance to the ability of a species to survive in sewage and lake water. Tests were conducted for periods of up to 14 days. Rhizobium meliloti and one fluorescent and one nonfluorescent strain of Pseudomonas were resistant to starvation because their population sizes did not fall appreciably in buffer and sterile lake water, and the first two maintained high numbers after being added to sterile sewage. Cell densities of these bacterial species dropped slowly in nonsterile sewage, and more cells these three organism than of the other test organisms remained in nonsterile lake water. Rhizobium leguminosarum was moderately resistant to starvation because its numbers fell slowly in buffer and sterile lake water did not change appreciably in sterile sewage. The abundance of Micrococcus flavus added to buffer and sterile lake water did not change, but the density of M. flavus declined in nonsterile lake water. The abundance of R. leguminosarum fell in nonsterile lake water and nonsterile sewage. Streptococcus faecalis, Staphylococcus aureus, an asporogenous strain of Bacillus subtilis, and Streptococcus sp. were susceptible to starvation because their populations were markedly reduced in buffer. Populations of the last three species declined rapidly in nonsterile samples of lake water and sewage. S. faecalis declined rapidly when added to nonsterile lake water and sewage and sterile lake water but not when added to sterile sewage, the persistence in the last instance probably being associated with the availability of organic nutrients. In a comparison of random isolates from nutrient-poor and nutrient-rich habitats, the percentage of survival of 17 of 19 bacteria from lake water was found to be greater than that of all 11 isolates from human skin and mouth. It is suggested that starvation-susceptible bacteria will not persist in environments that are nutrient poor or in which they fail to compete for organic nutrients and that starvation resistance is a necessary but not sufficient condition for persistence in environments that are nutrient poor or that support intense interspecific competition. (Author's abstract)
W85-02600

INFLUENCE OF WATER TEMPERATURE, SALINITY, AND PH ON SURVIVAL AND GROWTH OF TOXIGENIC VIBRIO CHOLERAE SEROVAR O1 ASSOCIATED WITH LIVE COPEPODS IN LABORATORY MICROCOSMS,
Maryland Univ., College Park. Dept. of Microbiology.
A. Huq, P. A. West, E. B. Small, M. I. Huq, and R. R. Colwell.
Applied and Environmental Microbiology, Vol. 48, No. 2, p 420-424, August, 1984. 6 Fig, 1 Tab, 17 Ref. WHO grant C6/181/70, PHS grant 5R22 A14242, NSF grant DEB-82-08418.

Descriptors: *Vibrio, *Water temperature, *Salinity, *Hydrogen ion concentration, *Copepods, Pathogenic bacteria, Cholera, Epidemiology, Estuarine environment.

The influence of water temperature, salinity, and pH on the multiplication of toxigenic Vibrio cholerae serovar O1 cells and their attachment to live planktonic crustaceans, i.e., copepods, was investigated by using laboratory microcosms. By increasing water temperatures up to 30 C, a pronounced effect on the multiplication of V. cholerae was demonstrated, as was attachment of the cells to live copepods. These were measured by culturable counts on agar plates and direct observation by scanning electron microscopy, respectively. Of the three salinities examined (5, 10, and 15%), maximum growth of V. cholerae and attachment to copepods occurred at 15%. An alkaline pH (8.5) was optimal both for attachment and multiplication of V. cholerae, as compared with pH 6.5 and 7.5. It is concluded that conditions affecting attachment of V. cholerae serovar O1 to live copepods observed under laboratory conditions may also occur in the natural estuarine environment and, thereby, are significant in the epidemiology of cholera. (Author's abstract)
W85-02601

R-PLASMID TRANSFER IN SALMONELLA SPP. ISOLATED FROM WASTEWATER AND SEWAGE-CONTAMINATED SURFACE WATERS,
Valencia Univ. (Spain). Dept. of Microbiology.
E. Alcaide, and E. Garay.
Applied and Environmental Microbiology, Vol. 48, No. 2, p 435-438, August, 1984. 3 Tab, 21 Ref.

Descriptors: *Bacteria, *Wastewater, *Salmonella, *R-plasmids, *Surface waters, Water pollution sources, Microbiological studies, Wastewater treatment, Albufera Lake, Spain, Antibiotic resistance.

A total of 865 Salmonella strains recovered from a wastewater treatment plant and from a hypereutrophic coastal lagoon (Albufera Lake, near Valencia, Spain) for antibiotic resistance by using NR10 medium and incubation at 43 C. Minimal inhibitory concentrations (MICs) and the ability to transfer resistance to a laboratory strain of Escherichia coli K-12 (nalidixic acid resistant) have also been investigated. Of the strains, 12.7% were resistant to one or more of the compounds tested. The MIC ranged between 25 and 1700 micro g/ml. The highest MIC generally corresponded to strains showing multiple resistance. Of the antibiotics tested, only one, streptomycin, was not transferable. Kanamycin was rarely transferred. Single and multiple P determinants were transferable in 30% of the strains. The incidence of resistance to antibiotics in the environmental Salmonella strains recovered in this study agrees with similar studies carried out in river waters. (Baker-IVI)
W85-02604

SOME CONSIDERATIONS ON ADEQUATE CONSTRUCTION OF BOX MODEL AND ITS APPLICATION,
National Inst. for Environmental Studies, Tsukuba (Japan).
K. Muraoka, and T. Fukushima.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 1, p 136-148, July, 1984. 6 Fig, 4 Tab, 7 Ref.

Descriptors: *Mathematical models, *Water quality, *Box models, Model studies, Lakes.

Water quality prediction is often necessary for the control of lakes. Of the prediction models for water quality which have been proposed, the box model is supposed to have a special functionality by reason of its simple procedure of calculation and its macroscopic presentation of water quality circumstances in spite of little input data. The simplest box model is a one box model where a whole lake is replaced by only one box. The method of adequate construction of a box model for the primary understandings of lake environment and its future aspects is considered. For actual application of this model a limitation in the usage will occur. At present stage the model is available for only the shallow lake in which one dimensional analysis is adaptable. Moreover, in order to set up the exchange flow, horizontally two-dimensional numerical analysis on lake current under arbitrary weather conditions is necessary, but recently it is not so difficult to pursue such a numerical computation. (Baker-IVI)
W85-02613

DYNAMICS OF DESORPTION OF MERCURY ABSORBED ON POORLY CRYSTALLINE OXIDES OF MANGANESE, IRON, ALUMINIUM, AND SILICON,
Saskatchewan Univ., Saskatoon. Dept. of Soil Science.
J. S. Rogers, P. M. Huang, U. T. Hammer, and W. K. Liaw.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 1, p 283-288, July, 1984. 1 Fig, 4 Tab, 18 Ref. Natural Sciences and Engineering Research Council of Canada grants A3248 G1296 and G0515.

Descriptors: *Fate of pollutants, *Mercury, *Lake sediments, *Desorption, Sediments, Aluminum, Iron, Manganese, Silicon, Oxides.

Most mercury which enters freshwater systems is taken up by bottom sediments. Because the formation of methylmercury depends on soluble mercury concentrations, release of mercury from bed sediments may be one of the main factors influencing the methylation and subsequent bioamplification of mercury in the food chain. The desorption of mercury adsorbed on poorly crystalline Al, Fe, Mn and Si oxides was investigated to aid in understanding the role of highly reactive oxides in the release and cycling of mercury in freshwater sediments. The rate of desorption of Hg adsorbed on these oxides was very slow and significantly varied with the nature of oxides and appeared to be controlled by diffusion. The cation exchange capacity, point of zero charge, surface area, and the total mercury adsorbed was not significantly correlated with mercury desorption. The data acknowledge the very substantial variations in the binding strengths between mercury and the surfaces of the oxides of these metals. (Baker-IVI)
W85-02627

MEASUREMENT OF OPERATIONALLY DEFINED LEAD FRACTIONS IN SEDIMENTS FROM SEVERAL LAKES,
Trent Univ., Peterborough (Ontario).
R. D. Evans, and C. J. Parliament.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 1, p 345-350, July, 1984. 3 Fig, 2 Tab, 18 Ref.

Descriptors: *Lead, *Lake sediments, *Ontario, Chemical reactions, Trace metals, Sediments, Hardness, Calcium, Fate of pollutants.

The differences between lakes in the lead extracted by MgCl2 and the reasons for those differences were investigated. Sediments were collected from 12 lakes in southern Ontario. Five chemical extractions were used on the sediments: MgCl2 extraction, NaOAc extraction, H2O2 extraction, weak acid extraction, and strong acid extraction. This procedure was not a sequential extraction. The six lakes with the hardest waters exhibit little or no lead in the MgCl2 extractable fraction while those with soft water show very high percentages of MgCl2 extractable lead. More lead was extracted in all sediments by the NaOAc extraction than by the MgCl2. The percentage extracted by NaOAc is quite constant across the range of lakes studied. The H2O2 extracted lead was the largest fraction in all sediments. An obvious relation is noted between the amount of lead extracted and the hardness of the lake water. A good relationship was found between the amount of lead extracted by MgCl2 and the amount of calcium in the epilimnion. This relationship suggests that the observed results are a consequence of natural conditions within the lake. Through studies such as this one tests can be designed to study the behavior of Pb both in the water column and after burial in the sediments. (Baker-IVI)
W85-02632

SEDIMENT GEOCHEMISTRY IN A EUTROPHIC LAKE COLONIZED BY THE SUBMERSED MACROPHYTE MYRIOPHYLLUM SPICATUM,
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
For primary bibliographic entry see Field 2H.
W85-02633

ALUMINUM SPECIATION IN SURFACE WATERS ON THE CANADIAN PRE-CAMBRIAN SHIELD,
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
For primary bibliographic entry see Field 2K.
W85-02634

PHYTOPLANKTON STANDING STOCK, SIZE DISTRIBUTION, SPECIES COMPOSITION AND PRODUCTIVITY ALONG A TROPHIC

GRADIENT IN GREEN BAY, LAKE MICHIGAN,
Lawrence Univ., Appleton, WI. Dept. of Biology.
For primary bibliographic entry see Field 2H.
W85-02640

TRACE METAL COMPOSITION OF AND ACCUMULATION RATES OF SEDIMENTS IN THE UPPER GULF OF THAILAND,
Skidaway Inst. of Oceanography, Savannah, GA.
H. L. Windom, S. Silpipat, A. Chanpongsang, R. G. Smith, Jr., and M. Hungspreugs.
Estuarine, Coastal and Shelf Science, Vol. 19, No. 2, p 133-142, August, 1984. 5 Fig, 2 Tab, 7 Ref. NSF grant INT81-16705.

Descriptors: *Sediments, *Gulf of Thailand, *Trace metals, *Chao Phraya, *Mae Klong, *Ta Chin, *Bang Pakong, Iron, Bays, Metals, Manganese, Aluminum, Fate of pollutants.

Sediment cores and grab samples were collected in the Upper Gulf of Thailand to determine sedimentation rates and to determine if metal concentrations reflect anthropogenic inputs. Accumulation rates of sediments in the Upper Gulf measured using the Pb-210 method, appear to vary from about 4 to 11 mm/year. Sediment budgets suggest that little of the sediment delivered to the Upper Gulf by the major rivers is ultimately transported to the Lower Gulf. Sediment discharge by the Chao Phraya River, the largest of the four rivers emptying into the Upper Gulf, is about 3400000 metric tons per year. The Gulf annually receives about 7000000 metric tons. Sediment transported by the Chao Phraya, Mae Klong, Ta Chin and Bang Pakong Rivers are for the most part deposited in the northern part of the Upper Gulf of Thailand. Metal concentrations in Upper Gulf sediments appear to be dominantly controlled by natural inputs, except for iron and manganese. (Baker-IVI)
W85-02654

BUOYANT CONTAMINANT PLUMES IN GROUNDWATER,
Harza Engineering Co., Chicago, IL.
N. W. Paschke, and J. A. Hoopes.
Water Resources Research, Vol. 20, No. 9, P 1183-1192, September, 1984. 5 Fig, 1 Tab, 13 Ref.

Descriptors: *Buoyant pollutants, *Plumes, *Groundwater pollution, *Mathematical models, Land disposal, Path of pollutants, Groundwater movement.

Buoyant contaminant groundwater plumes occur when liquid wastes which have densities different from groundwater are released from various land disposal activities (e.g., landfills, infiltration lagoons, injection wells). By using mass and momentum conservation equations, an analytical model for plume characteristics and behavior (namely, trajectory, concentration, and boundary) is developed for steady flow in a homogeneous, isotropic aquifer. The model predicts that plume behavior and characteristics are different close to the source from those far from the source. Solutions of the model yield dimensionless relations for the plume characteristics and behavior in each region in terms of length and concentration scales representing the combined effects of the source buoyancy flux and size and the ambient groundwater flow and dispersion. Experimental results, from a series of tests in a homogeneous, isotropic sand medium with a salt water discharge, are in reasonable agreement with model predictions. The model results have application to field problems under similar conditions. (Author's abstract)
W85-02660

DISPERSION OF TRACE SOLUTES IN FLOWING GROUNDWATER,
Wisconsin Univ.-Madison. Dept. of Chemical Engineering.
T. A. Hatton, and E. N. Lightfoot.
Water Resources Research, Vol. 20, No. 9, p 1253-1259, September, 1984. 5 Fig, 19 Ref, 1 Append.

Descriptors: *Solute transport, *Groundwater movement, *Dispersion, Stratified aquifers, Convective velocity, Mathematical models.

Generalized Taylor dispersion theory is used to identify the dispersion characteristics of simple stratified aquifers. The parameters routinely estimated from field tests are shown to be influenced in a nontrivial way by the inhomogeneity of the aquifer as well as by the initial distribution of solute and by the sampling techniques used in their determination; both the dispersion coefficient and apparent convective velocity can exhibit important transients. These factors are sufficient to explain the well-known scale effect for the idealized system analyzed. Furthermore, sampling procedures may require addition of a reaction term to the contracted diffusion equations normally used for analysis of field data if the model is to represent faithfully the dispersion processes occurring within the aquifer. (Author's abstract)
W85-02667

GEOSTATISTICAL APPROACH TO SOLUTE TRANSPORT IN HETEROGENEOUS FIELDS AND ITS APPLICATIONS TO SALINITY MANAGEMENT,
Agricultural Research Organization, Bet-Dagan (Israel). Div. of Soil Physics.
D. Russo.
Water Resources Research, Vol. 20, No. 9, p 1260-1270, September, 1984. 11 Fig, 1 Tab, 26 Ref.

Descriptors: *Salinity management, *Solute transport, *Leaching, *Saline soils, Permeability coefficient, Soil water, Mathematical models, Simulation, Pressure potential, Application rate.

In heterogeneous fields in which the soil water properties and the initial salinity vary under a deterministic water application rate uniform throughout the field, the salinity during leaching might also differ from place to place. A geostatistical approach was used to investigate the spatial variability of three soil properties: the saturated hydraulic conductivity Ks, the soil characteristic alpha = d log (K)/d(psi) (K being the soil hydraulic conductivity and psi being the pressure potential), and the dispersivity lambda, as well as the initial salinity EC sub 0, by using actual measured field data. These properties were used as input parameters of a simplified water and salt flow model, which in turn was coupled with the conditional simulation method to analyze the salinity profile and its spatial distribution during leaching in a 187-ha plot of land. Analysis of the results showed that 107 hours of continuous leaching (6527 cu m/ha) were required to obtain an average salinity of EC* = 5 dS/m for the field layer between the soil surface and the 40-cm depth. By considering the leaching of the different sites in the field, rather than that of the entire field, it was shown that, theoretically, the amount of water for leaching required to obtain EC* = 5 dS/m uniformly throughout the field can be reduced to 4038 cu m/ha (a reduction of 38%). Practically, since the field had to be subdivided into small subplots and because of engineering design requirements for the water supply system, the amount of water for leaching required to obtain the above-mentioned value of EC* for the entire field (519 cu m/ha) could be reduced by only 20%. (Author's abstract)
W85-02668

MODELING ORGANIC CONTAMINANT PARTITIONING IN GROUND-WATER SYSTEMS,
Michigan Univ., Ann Arbor.
C. T. Miller, and W. J. Weber, Jr.
Ground Water, Vol. 22, No. 5, p 584-592, September-October, 1984. 6 Fig, 37 Ref.

Descriptors: *Groundwater pollution, *Fate of pollutants, *Path of pollutants, Mathematical models, Partition coefficients, Solute transport, Sorption, Kinetics, Mass transport, Organic compounds.

Effective management of a ground-water system requires description and prediction of the transport and fate of contaminants in that system. This can be facilitated by using mathematical models which accurately represent the physical phenomena operative in the system. One of the most significant phenomena impacting the transport of many organic pollutants is partitioning between the solid (soil) and aqueous (ground-water) phases. The tendency of a contaminant to partition may be roughly approximated from measurements of such constitutive properties as the octanol:water partition coefficient of the contaminant and organic carbon content of the soil. Such rough approximations provide a basis for cursory appraisal, but are inadequate for quantitative system descriptions, particularly where nonlinear equilibrium sorption, kinetically dependent partitioning, or irreversible and/or hysteretic phase distribution phenomena are operative. Accurate simulation of solute transport frequently requires the incorporation of kinetic parameters and/or a nonlinear isotherm relationship to define transport phenomena in the fundamental equations governing mass transport. Laboratory measurements may be utilized to assess sorptive factors of importance, kinetic properties of an organic solute and a soil system, and equilibrium partitioning relationships. Such measurements can be utilized to provide more accurate modeling of contaminant transport. (Author's abstract)
W85-02692

MIGRATION OF CHLOROPHENOLIC COMPOUNDS AT THE CHEMICAL WASTE DISPOSAL SITE AT ALKALI LAKE, OREGON - 1. SITE DESCRIPTION AND GROUND-WATER FLOW,
Oregon Graduate Center, Beaverton.
J. F. Pankow, R. L. Johnson, J. E. Houck, S. M. Brillante, and W. J. Bryan.
Ground Water, Vol. 22, No. 5, p 593-601, September-October, 1984. 10 Fig, 24 Ref. EPA grant 808272.

Descriptors: *Alkali Lake, *Oregon, *Groundwater movement, *Hydrogeology Waste disposal, Chlorophenols, Industrial wastes, Playas, Springs, Water pollution sources.

The hydrogeology of the chemical waste disposal site in the closed basin at Alkali Lake, Oregon has been examined. Interest in the site is due to the burial (November 1976) of 25,000 drums of herbicide manufacturing residues in unlined trenches on the playa of the basin. Included in the wastes were large amounts of chlorophenols and polymeric chlorophenoxyphenols. The flow of the alkaline (pH about 10) ground water in the site area is driven by: (1) springs which create a mound east of the site; and (2) the sump effect of 'West Alkali Lake,' a topographic low to the west of the site. Porosity, bulk mass densities, and grain-size distributions were determined. At one piezometer, the depth to ground water ranged between 0.9 m and 2.2 m. With the bottoms of the trenches in which the chemicals were buried between 0.60 and 0.75 m below the level of the ground surface, the bottom portions of the trenches may, at least occasionally, be in direct contact with the ground water. (Author's abstract)
W85-02693

5C. Effects Of Pollution

RECOVERY OF DAMAGES BY STATES FOR FISH AND WILDLIFE LOSSES CAUSED BY POLLUTION,
F. Halter, and J. T. Thomas.
Ecology Law Quarterly, Vol. 10, No. 1, p 5-35, 1982. 124 Ref.

Descriptors: *Oil spills, *Cleanup, *Legal aspects, *Fish, *Wildlife, Legislation, Common law, Evaluation, Economic aspects, Chesapeake Bay, Bays.

In February of 1976 a tank barge carrying about 19,700 barrels of oil sank while in tow up the Chesapeake Bay. Much of the oil escaped into the Bay off Smith Point, just below the mouth of the Potomac River. Several months later the owner, Steuart Transportation Company, filed a complaint seeking exoneration from or limitation of liability for the damages caused by the spill. Both the United States and the Commonwealth of Virginia

filed claims. The several bases for state recovery actions are analyzed and investigation is made of various methods for establishing the monetary value of the fish and wildlife destroyed. While legal remedies are available through legislation and, in many cases, through state common law as well, the problem of determining the value of fish and wildlife has been a major factor in discouraging recoveries. Methods for valuing these resources are available. Some, like replacement cost, are well established. Newer methods for more difficult valuation problems are just developing and have not yet received much application. Specific authorizing legislation will facilitate state recovery efforts by establishing a sound legal basis and providing a framework for the development and use of a variety of valuation methods. The growing number of state actions and the statutory mandate of Superfund should lead to rapid progress in this area. (Baker-IVI)
W85-02181

TOXICITY OF COPPER TO THE ADULT AND EARLY LIFE STAGES OF THE FRESHWATER CLAM, CORBICULA MANILENSIS,
Lawrence Livermore National Lab., CA.
F. L. Harrison, J. P. Knezovich, and D. W. Rice, Jr.
Archives of Environmental Contamination and Toxicology, Vol. 13, No. 1, p 85-92, January, 1984. 3 Fig, 4 Tab, 41 Ref. DOE contract W-7405-ENG-48.

Descriptors: *Clams, *Copper, *Toxicity, *Growth stages, Heavy metals, Bioassay, Mortality, Bioaccumulation, Water pollution effects.

The copper sensitivity of adult and larval stages of the freshwater clam Corbicula manilensis was evaluated. In addition, copper concentrations were determined in adult clams exposed for 4 to 10 weeks to copper in a high-volume, flow-through bioassay. All bioassay systems utilized water that was low in total hardness and alkalinity. The response of the clams to copper depended on life stage. Copper sensitivity of larvae decreased markedly in successive developmental stages; 24 hr LC50 of veliger and juvenile larvae were 28 and 600 micro g Cu/L, respectively. The mortality of trochophore larvae exposed to 10 micro g Cu/L for one hr was 91.5%. The sensitivity to copper decreased with increased amounts of larval shell deposition. Adult clams were resistant to copper; the 96 hr LC50 was greater than 2,600 micro g Cu/L. By comparison, the incipient lethal concentration (ILC, was lowless than 10 micro g Cu/L. Adult clams accumulated more copper as concentrations in the water increased. Evidence was obtained for copper loss near or at death. Labile and total copper, as well as the copper-complexing capacity, in the bioassay water were determined; the majority of copper was present at labile species. Toxicity was related to the quantities of labile copper in the water. (Author's abstract)
W85-02193

INTRASPECIFIC VARIATION IN COPPER SUSCEPTIBILITY OF THE BLUEGILL SUNFISH,
Maryland Univ., Solomons. Chesapeake Biological Lab.
C. Tsai, and K. Chang.
Archives of Environmental Contamination and Toxicology, Vol. 13, No. 1, p 93-99, January, 1984. 4 Fig, 1 Tab, 18 Ref.

Descriptors: *Bluegills, *Copper, *Toxicity, Sex, Age, Size, Heavy metals, Bioassay.

The bluegill, Lepomis mocrochirus, is one of the most common species of freshwater fish in North America and is commonly used as a test species in toxicity tests of pollutants. Since intraspecific variables such as size, sex, and age might affect test results, the objective of this study was to determine the effects of these variables on the susceptibility of the bluegill to toxicants by using copper as a test chemical. For the same unit of effective concentration adjusted with size factor, the survival times of age-0 males, age-0 females, age-1 males and age-1 females were, respectively, 2.77, 2.88, 4.20 and 6.30 times that of the juveniles; susceptibility to the toxic effect of copper decreased from small to large, young to old, and male to female. Bluegills of 30-50 mm standard length (about 3 g) at age-0 are the best size for toxicity tests. (Moore-IVI)
W85-02194

TOXICITY, ACCUMULATION, AND ELIMINATION OF POLYCYCLIC AROMATIC SULFUR HETEROCYCLES IN DAPHNIA MAGNA,
Brigham Young Univ., Provo, UT. Dept. of Zoology.
D. A. Eastmond, G. M. Booth, and M. L. Lee.
Archives of Environmental Contamination and Toxicology, Vol. 13, No. 1, p 105-111, January, 1984. 8 Fig, 1 Tab, 36 Ref.

Descriptors: *Daphnia, *Toxicity, *Bioaccumulation, *Polycyclic aromatic sulfur heterocycles, Aromatic compounds, Hydrocarbons, Polycyclic aromatic hydrocarbons, Biological magnification, Industrial wastes.

Full-scale commercial synfuel plants would produce effluents containing polycyclic aromatic sulfur heterocycles (PASH), a portion of which would be released to the freshwater environment. The environmental effects of the PASH are largely unknown. A series of PASH were compared to their sterically and structurally similar polycyclic aromatic hydrocarbons (PAH) for toxicity, bioconcentration, and elimination in Daphnia magna. The PASH were generally more toxic than their analogous PAH. Benzo(b)thiophene and benzo(b)naphtho(2,1-d)-thiophene (BNT) were bioconcentrated to a greater extent than naphthalene and chrysene, respectively. Dibenzothiophene and phenanthrene exhibited similar uptake curves. No clear trend was observed for elimination differences between PASH and PAH, with those of BNT and chrysene being equal and those of bensol(b)thiophene and phenanthrene being slower than naphthalene and dibenzothiophene, respectively. (Moore-IVI)
W85-02195

INFLUENCE OF TETRACHLOROETHYLENE ON THE BIOTA OF AQUATIC SYSTEMS: TOXICITY TO PHYTO- AND ZOOPLANKTON SPECIES IN COMPARTMENTS OF A NATURAL POND,
Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Inst. fuer Okologische Chemie.
J. P. Lay, W. Schauerte, W. Klein, and F. Korte.
Archives of Enironmental Contamination and Toxicology, Vol. 13, No. 2, p 135-142, March, 1984. 7 Fig, 2 Tab, 19 Ref. Commission of the European Communities contract 187-77-1 ENV D.

Descriptors: *Tetrachloroethylene, *Toxicity, *Phytoplankton, *Zooplankton, Solvents, Chlorinated hydrocarbons, Daphnia, Aquatic life.

This study was designed to determine the effects of tetrachloroethylene on the phyto- and zooplankton community at initial concentrations of 1.2 and 0.44 mg/L in separated compartments of an experimental pond. Measurements in the surrounding water were made simultaneously to detect possible effects of compartmentalization. Residues as low as 0.1 mg/L could be analyzed 5 days (low dose) and 38 days (high dose) post application. In all applied biotopes, a lethal effect on the Daphnia population was detected. The phytoplankton community showed an increase of relative abundance and a decrease in species diversity. Studies of the frequency distribution of six selected phytoplankton species demonstrated the total elimination of at least four species from the treated compartments. In spite of different dosing, only weak differences could be found in toxic effects between the low and high dosed compartments. No significant chemical-induced effect was observed on the physico-chemical properties of the treated water. (Author's abstract)
W85-02196

TOXICOLOGICAL RESPONSE OF THE ALGA ANABAENA FLOS-AQUA (CYANOPHYCEAE) TO CADMIUM,
Herbert H. Lehman Coll., Bronx, NY. Dept. of Biological Sciences.
J. W. Rachlin, T. E. Jensen, and B. Warkentine.
Archive of Environmental Contamination and Toxicology, Vol. 13, No. 2, p 143-151, March, 1984. 9 Fig, 6 Tab, 44 Ref. EPA grant R-807035.

Descriptors: *Phytotoxicity, *Anabaena, *Cadmium, Algae, Water pollution effects, Heavy metals, Cellular compartmentalization, Intracellular structure.

The toxicological response of the cyanophycean alga Anabaena flos-aquae to cadmium was investigated by three integrated approaches: 1) the determination of the incipient lethal concentration of the metal, 2) study of metal incorporation and cellular compartmentalization using X-ray energy dispersive analysis, and 3) the quantification of intracellular structural changes, after metal exposure, using morphometic analysis. After 96 hr of exposure, the incipient lethal concentration was calculated to be 0.118 +/- 0.04 micro M cadmium. At concentrations three orders of magnitude higher than the incipient lethal concentration, cadmium was incorporated into both cellular cytoplasm and the cell's polyphosphate bodies. Cadmium also caused the polyphosphate bodies to lose Mg and Ca, resulting in ionic changes in the elemental composition of these cellular inclusions. The utilization of stereological techniques for electron microscopic morphometric analysis established that all concentrations of cadmium tested caused significant reductions in the surface area of the cell's thylakoids. Cadmium induced changes in the numbers and relative volume of the cell occupied by polyhedral bodies, polyphosphate bodies, lipid inclusions, cyanophycin granules, membrane limited crystalline inclusions, and changes in the volume of the cell wall layers were also documented. The physiological significance of these findings are discussed in terms of the toxic action of cadmium and the cellular mechanisms for detoxification of cations once they enter the cell. (Author's abstract)
W85-02197

HISTOPATHOLOGICAL, HEMATOLOGICAL, CONDITION-FACTOR, AND ORGAN WEIGHT CHANGES ASSOCIATED WITH SELENIUM ACCUMULATION IN FISH FROM BELEWS LAKE, NORTH CAROLINA,
Texas Univ. at Austin. Dept. of Pharmacology.
E. M. B. Sorensen, P. M. Cumbie, T. L. Bauer, J. S. Bell, and C. W. Harlan.
Archives of Environmental Contamination and Toxicology, Vol. 13, No. 2, p 153-162, March, 1984. 8 Fig, 3 Tab, 31 Ref.

Descriptors: *Selenium, *Sunfish, *Toxicity, *Belews Lake, *North Carolina, Bioaccumulation, Hepatopancreas, *Histopathology, Blood, Gills, Water pollution effects.

Green sunfish (Lepomis cyanellus) were collected from two study sites in Belews Lake, North Carolina, for assessment of correlations between several biological parameters and bioaccumulation of selenium. The fish had elevated concentrations of selenium in the hepatopancreas (liver) and exhibited histopathological and other manifestations of selenium poisoning. Condition-factors of Belews Lake fish were significantly correlated with selenium concentrations in hepatopancreas and sketetal muscle, indicative of capillary permeability changes and resultant edema, supported by the occurrence of significantly increased hepatopancreas-weight-to-body-weight ratios in the fish having the higher tissue selenium levels. Gill lamellae were noticeably swollen and vacuolated. Hematocrits of the selinium-contaminated fish were significantly lower than those of the reference fish. The hepatopancreas exhibited lymphocyte infiltration, vacuolation of parenchymal hepatocytes around the central veins, and increased numbers of Kupffer cells. The mesonephros exhibited focal intra-capillary proliferative glomerulonephritis. Hearts showed swollen, inflammatory cell-filled pericardial spaces, diagnosed as possible

uremia-induced pericarditis. Ovaries in fish with the higher liver selenium levels exhibited numerous necrotic and ruptured egg follicles. These conditions were observed in the Belews Lake Site 2 fish, but did not occur in reference green sunfish, nor did they occur consistently in fish from the less-contaminated Belews Lake Site 1. (Author's abstract)
W85-02198

MULTIPLE BIOASSAYS TO ASSESS THE TOXICITY OF A SANITARY LANDFILL LEACHATE,
Massachusetts Univ., Amherst. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5A.
W85-02202

TOXICITY OF SEWAGE SLUDGE TO RHEPOXYNIUS ABRONIUS, A MARINE BENTHIC AMPHIPOD,
Corvallis Environmental Research Lab., OR.
R. C. Swartz, D. W. Schults, G. R. Ditsworth, and W. A. DeBen.
Archives of Environmental Contamination and Toxicology, Vol. 13, No. 2, p 207-216, March, 1984. 2 Fig, 5 Tab, 42 Ref.

Descriptors: *Sludge, *Toxicity, *Amphipods, Volatile solids, Marine sediments, Water pollution effects, Sludge disposal.

Relative toxicity of sewage sludges from six treatment plants was determined by the LC50 of sludge-sediment mixtures to the infaunal marine amphipod, Rhepoxynius abronius. LC50s were measured as the increase in the percent total volatile solids (TVS) of the mixture due to the addition of sludge required to kill 50% of the amphipods during a 10-day exposure. LC50s ranged from 2.83% TVS addition for sludge from the small, domestic community of Waldport, Oregon to < 0.1% TVS addition for metropolitan, more industrialized source in Los Angeles, California. The toxicity of the sludge-sediment mixtures is attributed primarily to chemical contamination rather than organic enrichment. Rank correlations between toxicity and specific chemicals were usually not statistically significant, indicating that different combinations of stresses involving multiple or unmeasured factors were probably responsible for observed effects. Integrative measures of contamination (oil/grease concentration; consensus ranking of contamination based on 15 parameters) were significantly correlated with R. abronius survival indicating that the more toxic sludges had a higher overall level of contamination. (Author's abstract)
W85-02203

UPTAKE AND PHYTOTOXICITY OF SOIL-SORBED ATRAZINE FOR THE SUBMERGED AQUATIC PLANT, POTAMOGETON PERFOLIATUS L.,
Maryland Univ., Cambridge. Horn Point Environmental Labs.
T. W. Jones, and P. S. Estes.
Archives of Environmental Contamination and Toxicology, Vol. 13, No, 2, p 237-241, March, 1984. 3 Fig, 1 Tab, 19 Ref. EPA grant X003248010.

Descriptors: *Atrazine, *Herbicides, *Phytotoxicity, *Submerged plants, Photosynthesis, Soil adsorption, Macrophytes, Pesticide residues, Water pollution effects.

Herbicide runoff into estuarine aquatic environments may have an impact on submerged macrophyte vegetation. Triazine herbicides such as atrizine are relatively mobile in the soil and move from agricultural fields into aquatic systems. The partitioning of atrazine between the dissolved phase and the soil-sorbed phase in the runoff component may be of key importance to the availability of the herbicide for uptake by submerged macrophytes. The photosynthetic inhibitory effect of atrazine-sorbed soil placed on the leaf surfaces of Potamogeton perfoliatus was investigated under laboratory conditions. Leaves simultaneously exposed to atrazine both in solution and sorbed to soil exhibited a similar uptake of atrazine and associated photosynthetic reduction as did leaves exposed to the same concentration of atrazine in solution only. A small quantity of atrazine (0.19 micro g/gdw leaf) was found in leaves treated with atrazine-sorbed soil at 120 micro g/kg whereas a significantly larger amount (3.57 micro g/gdw leaf) was present in leaves treated with dissolved atrazine at a concentration of 100 micro g/L. Atrazine sorbed to soil on leaf surfaces is less available for uptake by aquatic plants than atrazine in solution. The physical presence of the soil on the leaves and the resultant reduction of light may be of greater physiological concern. (Moore-IVI)
W85-02205

BACTERIA AND CADMIUM INTERACTIONS IN NATURAL AND LABORATORY MODEL AQUATIC SYSTEMS,
Ohio State Univ., Columbus. Dept. of Microbiology.
J. A. Titus, and R. M. Pfister.
Archives of Environmental Contamination and Toxicology, Vol. 13, No. 3, p 271-277, May, 1984. 4 Fig, 3 Tab, 27 Ref. OWRT contract B-079-OHIO.

Descriptors: *Cadmium, *Bacteria, *Ottwa River, *Ohio, Heavy metals, River sediments, Aquatic environment, Water pollution effects, Bacillus, Pseudomonas.

Cadmium-resistant bacterial populations were examined in sediments of the Ottwa River, near Lima, Ohio, at a site that had elevated levels of Cd, Cr, Cu, Ni, Zn, and Fe. The percentage of the bacterial population that was resistant to cadmium was higher at the metal-contaminated site than at a less contaminated site downstream. Bacillus was the most abundant genus of the total river sediment population recovered and Pseudomonas was the most abundant Cd-resistant genus recovered. Types and distribution of bacterial populations in 40 liter laboratory model aquatic systems were examined over a ten-week period during the continuous addition of 10 mg Cd(+2) per day. The Cd level in the water column rose rapidly through the first two weeks and reached a maxium of 3 micro g Cd/ml. Sediment Cd levels rose most rapidly after 5 weeks and reached a concentration of 270 micro g Cd/g after 10 weeks. The bacteria in the water column responded to the Cd treatments with increased Cd resistance more quickly and to a greater degree than the bacteria in the sediment. The types of Cd-resistant bacteria isolated in the model systems were similar to Cd-resistant bacteria isolated from sediments of the Ottwa River. (Author's abstract)
W85-02206

PERSISTENCE AND EFFECTS OF CHEMICALS IN SMALL ENCLOSURES IN PONDS,
Shell Research Ltd., Sittingbourne (England). Sittingbourne Research Centre.
R. R. Stephenson, and D. F. Kane.
Archives of Environmental Contamination and Toxicology, Vol. 13, No. 3, p 313-326, May, 1984. 14 Fig, 3 Tab, 23 Ref.

Descriptors: *Water pollution effects, *Toxicity, *Enclosures, *Ponds, Aquatic plants, Aquatic animals, Persistence, Fate of pollutants, Insecticides, Herbicides, Methyl parathion, Linuron, Zooplankton, Invertebrates.

The use of small (1 cu m) enclosures for providing data on the persistence and effects of chemicals in freshwater was investigated. The enclosures included an intact water column with its associated flora and fauna and provided water/air and water/sediment interfaces when placed in small ponds. The enclosures provided a means of examining a variety of toxic effects of two chemicals, an insecticide (methyl parathion) and a herbicide (linuron), under relatively natural conditions in a replicated experiment which lasted six weeks. Toxic effects on zooplankton, macroinvertebrates, and the flora of the enclosures were observed and compared with the results of laboratory toxicity tests and bioassays of water samples collected from the enclosures. The persistence of the two chemicals in the water in the enclosures was followed by chemical analysis and bioassay. Experiments in enclosures could play a role in providing data to be used in the assessment of the hazard posed by chemicals: particularly in cases where the laboratory data in acute toxicity, to single species or simple associates of species, and knowledge of simple physical constants are inadequate to allow assessment of the hazard. (Author's abstract)
W85-02207

COPPER COMPLEXATION AND TOXICITY TO FRESHWATER ZOOPLANKTON,
Canada Centre for Inland Waters, Burlington (Ontario).
U. Borgmann, and K. M. Ralph.
Archives of Environmental Contamination and Toxicology, Vol. 13, No. 4, p 403-409, July, 1984. 5 Fig, 1 Tab, 19 Ref.

Descriptors: *Copper, *Toxicity, *Zooplankton, *Complexation, Copepods, Rotifers, Tris, Bioassay, Growth.

The effect of copper on the growth rate of cyclopoid copepods and survival of rotifers was determined in natural water with and without addition of the complexing agent Tris. Free copper concentrations were estimated, both by cupric ion electrode and from the bioassay data, making use of the known complexing ability of Tris and the increase in total copper tolerated after Tris addition. Growth rates of copepods were directly related to free copper concentrations indicating that the copper-Tris complex was not toxic to these animals. Rotifer survival was similar at equivalent free copper concentrations in water with and without 1 mmole/L Tris, but addition of 3 mmole/L Tris resulted in slightly lower free copper at equivalently toxic total copper concentrations. Free copper concentrations calculated from bioassay data compared well with electrode measurements in all cases except when calculated using the 3 mmole/L Tris data for rotifers, when free copper concentrations were slightly overestimated. (Author's abstract)
W85-02211

EFFECTS OF LAKE ACIDIFICATION ON RATES OF ORGANIC MATTER DECOMPOSITION IN SEDIMENTS,
Winnipeg Univ. (Manitoba). Dept. of Biology.
C. A. Kelly, J. W. M. Rudd, A. Furutani, and D. W. Schindler.
Limnology and Oceanography, Vol. 29, No. 4, p 687-694, July, 1984. 4 Fig, 2 Tab, 20 Ref.

Descriptors: *Acidification, *Decomposition, *Organic matter, *Lake sediments, Acid lakes, Hydrogen ion concentration, Microorganisms, Atmospheric deposition, Epilimnion.

Decomposition was monitored in Lake 223, a Canadian Shield lake within the Experimental Lakes Area, as the lake was being experimentally acidified by additions of sulfuric acid. Summer hypolimnetic and whole-lake under-ice measurements in the acidified lake suggested that rates of in situ decomposition in sediments (measured as methane and inorganic carbon release) were unaffected over an epilimnetic pH range of 6.7-5.1. This was apparently because microbial process kept the pH at 6.0 or above just a few millimeters below the sediment surface even after lake water had been acidified for 8 years. In laboratory studies where the pH of mixed, fresh lake sediment was controlled at reduced levels, decomposition rates of carbon that had been made in the sediments for several months were unaffected at pH values as low as 4.0. Decomposition rates of newly sedimented material began to decrease at pH 5.25-5.0. Decomposition processes were less affected during the acidification of Lake 223 than were higher life forms. The kinds of pH and decomposition phenomena seen in Lake 223 may be expected in other lakes receiving acid precipitation, but rates of atmospheric inputs of acid are lower than the experimental rate of acidification. (Moore-IVI)
W85-02218

INSECTICIDE TOXICITY TO MACROBRACHIUM LAMARREI (H. MILNE EDWARDS) (DECAPODA, PALAEMONIDAE),
Gorakhpur Univ. (India). Dept. of Zoology.
G. S. Shukla, and Omkar.
Crustaceana, Vol. 46, No. 3, p 283-287, May, 1984. 1 Tab, 19 Ref.

Descriptors: *Water pollution effects, *Insecticides, *Aquatic animals, Organochlorines, Organophosphates, Endosulfan, Methyldemeton, Carbaryl, Organocarbamates, Organic compounds.

Three commonly used insecticides were tested for their short-term toxicity to a freshwater prawn, Macrobrachium lamarrei, which is a valuable source of food for fishes and humans and is abundantly available in local water sources. The animals were restless in the test solutions of each insecticide, earlier at higher concentrations than in lower ones. The first indication of insecticide poisoning was irritability, followed by impaired locomotion, restriction of appendage movement and finally death occurred. Symptoms of poisoning were somewhat similar for all insecticides. The organochlorine insecticide endosulfan was highly toxic, 568.5 times more toxic than the organophosphate methyldemeton, which is least toxic to this species and the carbamate carbaryl is intermediate in toxicity. In 0.002, 0.5 and 0.0175 mg/l solutions of endosulfan, methyldemeton, and carbaryl, respectively, no mortality occurred in 96 hr while in 0.0075, 6.0 and 0.065 mg/l solutions of endosulfan, methyldemeton and carbaryl, respectively, 10% mortality occurred within 24 hr. (Baker-IVI)
W85-02235

EFFECTS OF WATER POLLUTION ON PLANT SPECIES COMPOSITION ALONG THE AMAL RIVER, ISRAEL,
Ben-Gurion Univ. of the Negev, Sde Boker (Israel). Jacob Blaustein Inst. for Desert Research.
M. Agami.
Archiv fur Hydrobiologie, Vol. 100, No. 4, p 445-454, July, 1984. 2 Fig, 2 Tab, 9 Ref.

Descriptors: *Vegetation, *Water pollution effects, *Amal River, *Harod River, *Israel, Water quality, Dissolved oxygen, Chemical oxygen demand, Biochemical oxygen demand, Suspended solids, Ammonia, Nitrates, Salinity, Detergents.

The effect of increasing pollution levels in the Amal river system on the vegetation in that system was evaluated. Water quality measurements taken in the Amal and Harod Rivers included determinations of nitrate, ammonium, total dispersed solids, biochemical oxygen demand, chemical oxygen demand, detergent, dissolved oxygen and calcium. Section 1 of the study area (a 700 m section of Amal river from its source to a point 200 m before the dam) had water which remained pure throughout the year. Water in Section 2 of the study area (a 1000 m section of Amal River from the first sewage dump to the beginning of an irrigation canal) was only slightly polluted indicating that the dilution of the sewage by the water was very large (1:219). Section 3 (a section of Harod River which receives some 20,000 cu m/day of urban and industrial sewage) was heavily polluted. The level of dissolved oxygen was only about 31% of air equilibrium and detergents and ammonium were always present with ranges of 1.7 to 2.4 ppm and 3.71 to 12.35 ppm, respectively. Only one third of the species of vegetation which exist in the unpolluted sections manage to live also in the polluted ones. The flora of the Amal River system is generally poor. The Amal River is also of relatively high salinity compared to the Yarkon and Alexander Rivers which contain 47 and 81 species respectively compared to the 22 species of vegetation found in the Amal River. In the clean sections of this study site submerged, floating and emergent species are present. In the polluted section all plants have disappeared from the water body with only bank vegetation remaining. (Baker-IVI)
W85-02239

PHYTOPLANKTON LIMITATION BY PHOSPHORUS AND ZOOPLANKTON GRAZING IN AN ACIDIC ADIRONDACK LAKE,
Syracuse Univ., NY. Dept. of Civil Engineering.
R. Singer, G. L. Evans, and N. C. Pratt.
Journal of Freshwater Ecology, Vol. 2, No. 5, p 423-434, August, 1984. 46 Ref.

Descriptors: *Phytoplankton, *Zooplankton, *Phosphorus, *Acid lakes, *New York, Mountain lakes, Acidity, Algal growth, Predation, Water pollution effects.

Lakes which are believed to have been acidified by atmospheric deposition of anthropogenic substances are known for their unusually high water clarity and low nutrient concentrations. Some evidence indicates that alterations in predator/prey relationships, an indirect effect of acidification, bring about the increase in water clarity. Enclosures were used to study the effects of phosphorus addition and zooplankton removal on the phytoplankton of an acidic lake in the Adirondak Mountains of New York. Fertilized enclosures had significantly lower alkalinities and contained significantly more dissolved oxygen after the incubation period than did unfertilized enclosures. The P concentration remained at or near the limit of detection in the unfertilized enclosures. The phytoplankton population bloomed after the addition of 80 micro g/liter of phosphate as KH2PO4. The response was measured by cell counts of the dominant phytoplankton, Chlamydomonas, and by changes in chlorophyll a concentration. About half the number of algal cells were present after the two week incubation when zooplankton were not removed, indicating that zooplankton herbivory can influence, but not totally control, the algal production. (Baker-IVI)
W85-02243

EFFECT OF MINERAL ACIDS AND ALUMINUM FROM COAL LEACHATE ON SUBSTRATE PERIPHYTON COMPOSITION AND PRODUCTIVITY,
Massachusetts Univ., Amherst. Dept. of Environmental Sciences.
B. Tease, and R. A. Coler.
Journal of Freshwater Ecology, Vol. 2, No. 5, p 459-467, August, 1984. 3 Fig, 2 Tab, 22 Ref.

Descriptors: *Leachates, *Acid mine drainage, *Massachusetts, *Taylor Brook, *Swamps, Water pollution effects, Periphyton, Population dynamics, Primary productivity.

Taylor Brook drains agricultural and grazing land surrounding Hawley swamp in North Amherst, Massachusetts. It is a second order stream, with an average flow of less than 4 cfs in the study area, and a total length of 5 km. Riparian vegetation occurs mainly as aspens. Silt and sand, together with stretches of gravel, make up the stream bed. The test site is within a pasture, 1 km below a coal leachate seepage problem and 10 m above the confluence of a first order tributary. Shifts in pH from 6.8 to 4.4 and in aluminum from 0.03 to 3.8 ppm were noted in the stream. Tubular substrates, colonized by the indigenous periphyton of a clean water tributary were transferred to the contaminated stream and monitored for structural and functional perturbations. Net productivity, measured by oxygen evolution, was reduced to zero after 10 days exposure to the polluted stream. All diatom and cyanobacteria motility ceased. Low pH alone proved sufficient to eliminate net productivity, but it did not restrict algal movement. (Baker-IVI)
W85-02246

EFFECT OF SODIUM NAPHTHENATE ON SURVIVAL AND SOME PHYSIOLOGICAL-BIOCHEMICAL PARAMETERS OF SOME FISHES,
Kaspiiskii Nauchno-Issledovatel'skii Inst. Rybnogo Kozyaistava, Makhachkala (USSR).
B. K. Dokholyan, and A. K. Magomedov.
Journal of Ichthyology, Vol. 23, No. 6, p 125-132, 1983. 6 Fig, 6 Tab, 6 Ref.

Descriptors: *Water pollution effects, *Organic compounds, *Fish, *Toxicity, Naphthenic acid, Sodium naphthenate, Salmon, Roach, Kutum, Sturgeon, Goby.

The toxicity of the alkaline salt of naphthenic acid for some Caspian fish species was determined. The findings confirm the differential sensitivity of different species to the various toxic reagents during ontogeny. The concentrations not affecting adversely the life processes of fish species investigated are: 0.57 mg/l for young kutum; 0.332 mg/l for young chum salmon; 4.8 mg/l for young roach; 8.9 mg/l for adult roach; 6.3 mg/l for sturgeon; and 9.0 mg/l for Caspian round goby. In spite of relative resistance estimated on the basis of survival in the case of sturgeon, roach and round goby, significant changes in the blood components and carbon metabolism were observed in these fish even at lower toxicant concentrations. On the basis of hematological and biochemical parameters, the harmless concentrations of sodium naphthenate for these species were only 0.5 and 1.0 mg/l, respectively. Sodium naphthenate is similar in its effect to crude oil on the basis of its action on physiological-biochemical parameters in fish. The maximum permissible concentration of sodium naphthenate for the fish species studied has been fixed at 0.8 mg/l. Considering that other hydrobionts were even more sensitive than fishes, the maximum permissible content of sodium naphthenate in sea water should be considered 0.15 mg/l. (Baker-IVI)
W85-02280

AGRICULTURE AND STREAM WATER QUALITY: A BIOLOGICAL EVALUATION OF EROSION CONTROL PRACTICES,
North Carolina Dept. of Natural Resources and Community Development, Raleigh.
D. R. Lenat.
Environmental Management, Vol. 8, No. 4, p 333-344, July, 1984. 10 Tab, 31 Ref.

Descriptors: *North Carolina, *Water quality, *Erosion control, *Ecological effects, *Agricultural runoff, Benthos, Aquatic insects, Sedimentation, Water pollution effects, Caddisflies, Mayflies, Stoneflies.

Agricultural runoff affects many streams in North Carolina. However, there is little information about either its effect on stream biota or any potential mitigation by erosion control practices. In this study, benthic macroinvertebrates were sampled in three different geographic areas of North Carolina, comparing control watersheds with well-managed and poorly managed watersheds. Agricultural streams were characterized by lower taxa richness (especially for intolerant groups) and stability. These effects were most evident at the poorly managed sites. Sedimentation was the apparent major problem, but some changes at agricultural sites implied water quality problems. The group most intolerant of agricultural runoff were Ephemeroptera, Plecoptera and Trichoptera. Tolerant species were usually filter-feeders or algal grazers, suggesting a modification of the food web by addition of particulate organic matter and nutrients. This study clearly indicates that agricultural runoff can severely impact stream biota. However, this impact can be greatly mitigated by currently recommended erosion control practices. (Author's abstract)
W85-02296

RECREATIONAL IMPACTS ON COLORADO RIVER BEACHES IN GLEN CANYON, ARIZONA,
Museum of Northern Arizona, Inc., Flagstaff. Dept. of Biology.
S. W. Carothers, and R. A. Johnson.
Environmental Management, Vol. 8, No. 4, p 353-358, July, 1984. 4 Tab, 9 Ref. National Park Service contract CX82100022.

Descriptors: *Glen Canyon, *Colorado River, *Arizona, *Beaches, *Recreation wastes, *Environmental impact, Parks, Recreation facilities, Camp sites, Management planning.

Recreational impact was measured on eight beaches in Glen Canyon Recreation Area and 15 beaches in Grand Canyon National Park using permanently located transects and plots. Recreational impact indices included densities of human trash and charcoal and a measure of sand discoloration due to

charcoal. Significant increases in the indices occurred on several Glen Canyon beaches over a seven-month period. Sand discoloration became significantly higher over all Glen Canyon beaches during the same time period. All indices were significantly higher in Glen Canyon than on similar Grand Canyon beaches. These differences are probably due to differences in: (a) level of impacts tolerated by the respective management regimes and (b) in the number of user days among the two National Park Service administrative units. Management alternatives are presented for reversing the present trends of recreational impact on Glen Canyon beaches. (Author's abstract)
W85-02298

MARINE DISPOSAL OF MINE TAILING,
Victoria Univ. (British Columbia). Dept. of Biology.
J. L. Littlepage, D. V. Ellis, and J. McInerney.
Marine Pollution Bulletin, Vol. 15, No. 7, p 242-244, 1984. 12 Ref.

Descriptors: *Mine wastes, *Marine environment, *Waste disposal, Mercury, Lead, Cadmium, Radionuclides, Environmental effects, Environmental impact assessment.

The potential impacts of a mine-mill discharging to the marine ecosystem can be grouped into a three-compartment conceptual model. The first compartment includes the chemical composition and chemical behavior of the tailing slurry, the second, the physical behavior of the submerged tailing flow, and the third, changes in the receiving ecosystem. Consideration of the type of potential impacts should form the starting point for predicting and assessing environmental alteration. Primary impacts arise from suspended and settling particulate material and soluble components of the discharge. Secondary impacts may include reduced primary production, alteration including depletion of the biotic community and incorporation of metals into the food chain. Variable oceanographic conditions in some areas may make control of a tailing stream difficult and surveys must be undertaken to determine if currents are present which may intersect descending tailing flows or resuspend settled tailing. Greatest concern is with toxic metals, cadmium and lead; with metals known to biomagnify, mercury; and with radionuclides. The ecosystem component of the environmental impact assessment should emphasize assessing the relative complexity of the ecosystem, the fisheries present, their socio-economic importance as resources, and the nature of their dependence on ecosystem processes. (Baker-IVI)
W85-02324

EFFECT OF SEWAGE EFFLUENT ON THE POPULATION DENSITY AND SIZE OF THE CLAM PARVILUCINA TENUISCULPTA,
University of Southern California, Los Angeles. Dept. of Biological Sciences.
R. Fabrikant.
Marine Pollution Bulletin, Vol. 15, No. 7, p 249-253, July, 1984. 5 Fig, 15 Ref.

Descriptors: *Nitrogen compounds, *Water pollution effects, *Clams, *Wastewater outfall, Outfall sewers, Bioindicators, Population dynamics.

The population density and size of Parvilucina tenuisculpta in relation to the distance the clams were located from a municipal wastewater outfall were investigated. The contribution of organic enrichment to the changes in the population and size of the clams was calculated as measured by sediment organic nitrogen concentration. Definite responses and changes in size and density were noted along the distance gradient from the Whites Point outfall. Average clam size increased as sediment organic nitrogen concentration increased, but population density increased until organic nitrogen concentration reached a critical level when population density decreased dramatically. These effects were explained in terms of increased available nutrition in the form of sediment organic nitrogen pollutants which enhanced both population and individual size growth. At this critical level, however, population density decreased due to the toxicity of the released compounds. Parvilucina tenuisculpta may be a good bioindicator of organic enrichment pollution. (Baker-IVI)
W85-02325

STUDY OF PERIPHYTON IN A POLLUTED SECTION OF A VAROISE RIVER, THE ARGENS. SPATIAL EVOLUTION OF THE ALGAL POPULATION DURING A PERIOD OF INTENSE POLLUTION (ETUDE DU PERIPHYTON D'UN SECTEUR POLLUE D'UNE RIVIERE VAROISE, L'ARGENS. EVOLUTION SPATIALE DU PEUPLEMENT ALGAL EN PERIODE D'INTENSE POLLUTION),
Aix-Marseille-3 Univ. (France). Lab. de Biologie Animale et Ecologie.
N. Galvin-Chabriere, and A. Cazaubon.
Annales de Limnologie, Vol. 19, No. 3, p 169-178, 1983. 6 Fig, 20 Ref.

Descriptors: *Varoise River, *Argens, *France, *Periphyton, *Species composition, Physicochemical properties, Aquatic productivity, Water pollution effects, Euglenophyta, Chlorophyta, Cyanophyta, Diatoms.

The objectives of this study were to follow changes in a water body that was subjected to organic pollution from urban and industrial effluents. The evolution of the pollution load as well as its impact on the chief abiotic and biotic parts of the aquatic ecosystem were studied by taking monthly readings of physical-chemical variables and samples of periphyton. Changes in algal production, and the composition and structure of the periphyton were followed in a 10 km stretch by using artifical substrata that were renewed every 12 days. In the study zone, there was a progressive change from an algal population of low diversity (chiefly Euglenophyceae, Chlorophyceae and Cyanophyceae) in the polluted environment, to a diverse population dominated by diatoms in the section downstream. This investigation shows that algal populations integrate the environmental conditions and show through their composition and structure the variations in water quality, thus reflecting the spatial changes in hydrochemical conditions. (Author's abstract)
W85-02327

SYSTEM THEORY FORMULATION OF SITE-SPECIFIC WATER QUALITY STANDARDS AND PROTOCOLS,
Georgia Univ., Athens. Dept. of Zoology.
B. C. Patten.
Ecological Modelling, Vol. 23, No. 14, p 313-340, July, 1984. 6 Ref.

Descriptors: *Water quality standards, *Site specific standards, *Habitat variability, Decision making, Aquatic habitats, Standards, Toxicology, Systems analysis, Ecological effects, Water pollution effects.

The water bodies and wetlands of the United States host hundreds of ecological communities composed of thousands of interacting species, each with its own tolerances and preferences for physical and chemical factors of water quality. Habitat variability makes site-specific considerations a necessity in the specification of water quality standards. The U.S. Environmental Protection Agency (EPA) has recognized this in its development of procedures for site-specific modification of national standards. These procedures involve translation of laboratory toxicology data into field situations where such data are often poor predictors of biotoxicity. As formulated by the EPA, the site-specific problem was poorly specified. The legally defined objective of both National and Site-Specific Guidelines is to maintain the physical, chemical, and biological integrity of the environment. This can be framed in terms of general dynamical (state space) systems defined by a state transition function and a response (output) function. Development of site-specific environmental protection protocols must first involve finding a set of diagnostic variables whose maintenance within specifiable limits (standards) is both necessary and sufficient to protect all variables of a subject ecosystem. Standards for these variables must be determined through toxicity testing. Problems associated with determination of standards include: (a) spatiotemporal variability, (b) system linearity-nonlinearity, (c) system stationarity-nonstationarity, and (d) monitoring for baseline information, impact detection, compliance montoring, establishment of causality, and prediction. Further efforts to develop a more practically oriented theory within the general systems framework provided would be well advised; the present theory can serve to generally guide future methodological development. (Collier-IVI)
W85-02340

USE OF ELECTROPHORESIS AND IMMUNOELECTROPHORESIS IN TAXONOMIC AND POLLUTION STUDIES,
National Inst. of Oceanography, Panaji (India).
M. R. Menezes, and S. Z. Qasim.
Proceedings of the Indian Academy of Science (Animal Science), Vol. 93, No. 3, p 179-198, April, 1984. 6 Fig, 6 Tab, 50 Ref.

Descriptors: *Electrophoresis, *Tilapia, *Immunoelectrophoresis, *Water pollution effects, *Sublethal effects, Mercury, Immune system, Stress, Fish, Bioassay.

Stress conditions in fish may cause significant changes in the proteins of blood serum, hemoglobin, and eye lens proteins. Such changes might reflect an altered antibody synthesis, protein biosynthesis, cellular leakage, or perhaps other events resulting directly or indirectly from the stress. Long-term and short-term effects of inorganic mercury (mercuric chloride) on the electrophoresis patterns of a freshwater fish, Tilapia mossambica, were investigated under controlled conditions. Collateral studies included the uptake of mercury by the fish. The electrophoretic patterns of the serum and hemoglobin showed changes in response to low concentrations of mercury; these changes in number, mobility, and intensity of the fractions became evident in the serum proteins at a 0.04 ppm mercury exposure level. At this concentration, feeding behavior and swimming activity were altered and mercury concentrations in the blood increased. There was a general increase in the intensity of the low mobility serum protein fractions - a pattern similar to that found in the mammalian species under stress. Similar changes were also seen in the serum proteins of the fish exposed to relatively higher concentrations of mercury which were just below the lethal level. There is evidence that the low mobility proteins in the fish serum function as antibodies; this would indicate that the increased levels of these proteins in the exposed fish is due to a rapid and vigorous immune system response. Such indicators of stress responses would be useful for testing whether or not an effluent or a body of water containing a mixture of chemicals will collectively have a stressful effect on fish; the response would reflect the summation of effects, including synergistic effects, of pollutants. (Collier-IVI)
W85-02343

CHEMICAL POLLUTANTS IN SEDIMENTS AND DISEASES OF BOTTOM-DWELLING FISH IN PUGET SOUND, WASHINGTON,
National Marine Fisheries Service, Seattle, WA. Northwest and Alaska Fisheries Center.
D. C. Malins, B. B. McCain, D. W. Brown, S.-L. Chan, and M. S. Myers.
Environmental Science and Technology, Vol. 18, No. 9, p 705-713, 1984. 5 Fig, 4 Tab, 65 Ref.

Descriptors: *Puget Sound, *Washington, *Fish diseases, *Sediments, *Water pollution effects, Sole, Toxicicty, Organic compounds.

A 4-year multidisciplinary study was conducted on relationships between pollutants and diseases of fish in Puget Sound, WA. In this study, high concentrations of a large number of anthropogenic chemicals were found in certain Puget Sound sediments. For example, over 900 individual organic compounds were detected in sediment from one urban bay (Commencement Bay), and evidence was obtained for the presence of numerous additional compounds. Many of the chemicals accumu-

lated in bottom-dwelling fish, and high levels of certain toxic chemicals in the urban bays were linked to serious disease (e.g., liver carcinomas) of English sole (Parophrys vetulus) and other demersal fish species. Application of the approach used would reveal comparable serious pollution-related health problems in marine biota in other urban coastal areas of the world. (Author's abstract)
W85-02347

ECOTOXICOLOGICAL ASSAYS WITH ALGAE: WEIBULL DOSE-RESPONSE CURVES,
Wisconsin Univ.-Milwaukee. Dept. of Civil Engineering.
E. R. Christensen, and N. Nyholm.
Environmental Science and Technology, Vol. 18, No. 9, p 713-718, 1984. 3 Fig, 4 Tab, 19 Ref. NSF grant CEE8103650.

Descriptors: *Toxicology, *Algae, *Weibull dose-response curves, *Weibull model, *Bioassay, Selenastrum, Scenedesmus, Potassium dichromate, Dichlorophenol, Dose-response curve, Model studies, Logit models, Probit models.

A newly proposed Weibull model was compared to the probit and logit models for the growth rate of algae as a function of the concentration of metallic and organic toxicants. Four batch assays with Selenastrum capricornutum exposed to potassium dichromate and copper and with Scenedesmus suspicatus affected by 3,5-di-chlorophenol and potassium dichromate were carried out. Literature data for four other experiments were also examined. The data fitting was based on linear transformations of the three models using proper weighting. The Weibull model was at least as appropiate as the probit and logit models. The effective concentrations giving 10 and 90% growth rate reduction, EC10 and EC90, were generally lowest for the Weibull model. The slopes (0.5 to 3-5) in the Weibull and logit transformations may be interpreted as the number of toxicant molecules reacting per active receptor of the organism. (Author's abstract)
W85-02348

ROLE OF FISH DISTRIBUTION ON ESTIMATES OF STANDING CROP IN A COOLING RESERVOIR,
Fish and Wildlife Service, Clemson, SC. Southeast Reservoir Investigations.
D. H. Barwick.
North American Journal of Fisheries Management, Vol. 4, No. 3, p 308-313, 1984. 2 Fig, 1 Tab, 15 Ref.

Descriptors: *Fish management, *Cooling reservoirs, *Keowee Reservoir, *South Carolina, Cooling water discharge, Water pollution effects, Stratification, Reservoir fisheries, Fish migration, Water temperature, Dissolved oxygen.

Estimates of fish standing crop from coves in Keowee Reservoir, South Carolina, were obtained in May and August for 3 consecutive years. Estimates were significantly higher in May than in August for most of the major species of fish collected, suggesting that considerable numbers of fish had migrated from the coves by August. This change in fish distribution may have resulted from the operation of a 2,580-megawatt nuclear power plant which altered reservoir stratification. Because fish distribution is sensitive to conditions of reservoir stratification, and because power plants often alter reservoir stratification, annual cove sampling in August may not be sufficient to produce comparable estimates of fish standing crop on which to assess the impact of power plant operations on fish populations. Comparable estimates of fish standing crop can probably be obtained from cooling reservoirs by collecting annual samples at similar water temperatures and concentrations of dissolved oxygen. (Author's abstract)
W85-02374

AGE AND GROWTH OF LARGEMOUTH BASS IN A THERMALLY ALTERED RESERVOIR, AS DETERMINED FROM OTOLITHS,
Illinois Natural History Survey, Champaign.
L. G. Perry, and J. A. Tranquilli.
North American Journal of Fisheries Management, Vol. 4, No. 3, p 321-330, 1984. 6 Fig, 3 Tab, 33 Ref.

Descriptors: *Coffeen Lake, *Illinois, *Bass, *Thermal pollution, *Otoliths, *Reservoirs, *Growth, Water pollution effects, Fish physiology, Water temperature.

Comparative growth rates of largemouth bass (Micropterus salmoides) from heated and ambient areas of Coffeen Lake, Illinois, were estimated by back calculation of lengths at annuli using transverse sections of otoliths and by recovery of marked fish after one growing season. Calculated lengths at otolith annuli were judged to be representative of the population growth, indicating that this technique was a reliable approach to obtaining growth information on largemouth bass from thermally affected environments. Growth of the Coffeen Lake population was more rapid than most other midwest populations. Fish recaptured in heated areas generally exhibited greater annual growth increments than those recaptured in ambient areas. Young largemouth bass (ages 1-4) from heated areas had significantly greater ($P < 0.05$) mean lengths than those from ambient areas according to back-calculated estimates. This was attributed to a longer growing season and earlier hatching time in thermally affected areas. (Author's abstract)
W85-02376

PHARMACOKINETIC MODEL FOR THE UPTAKE AND DISPOSITION OF DI-2-ETHYLHEXYL PHTHALATE IN SHEEPSHEAD MINNOW CYPRINODON VARIEGATUS,
Washington State Univ., Pullman. Coll. of Pharmacy.
A. H. Karara, and W. L. Hayton.
Aquatic Toxicology, Vol. 5, No. 3, p 181-195, 1984. 5 Fig, 2 Tab, 34 Ref. NIH grant ES01995.

Descriptors: *Phthalates, *Pharmacokinetics, *Sheepshead minnows, Plasticizers, Toxicology, Bioconcentration, Fate of pollutants, Water pollution effects, Metabolism, Fish physiology.

Sheepshead minnow Cyprinodon variegatus were placed individually in a 2 L solution that contained 60 nano g (C-14)di-2-ethylhexyl phthalate (DEHP)/ml at 23 degrees C. After various periods of exposure, fish and water were analyzed for unchanged DEHP and total metabolites. A two-compartment pharmacokinetic model was developed to characterize the uptake and disposition of DEHP. In the model, DEHP reversibly entered a relatively small compartment where it predominantly underwent metabolism. A small fraction of the absorbed DEHP moved into the second relatively large storage compartment. After depletion of the external solution of DEHP, the rate of metabolism slowed, due to the slow return of DEHP from the storage compartment to the metabolic compartment. The magnitude of the absorption clearance was similar to the gill blood flow, and indicated that the uptake of DEHP was blood flow rate limited. The metabolic clearance of DEHP was much larger (29-fold) than the absorption clearance and it therefore appeared that metabolism prevented the accumulation of DEHP to a level that in the absence of metabolism would have been much higher. The model-predicted bioconcentration factor and depuration half-life of DEHP were 637 and 38 days, respectively. (Author's abstract)
W85-02377

STRUCTURE AND FUNCTION OF COPPER-STRESSED AQUATIC MICROCOSMS,
Environmental Research Lab.-Duluth, Monticello, MN. Monticello Ecological Research Station.
S. F. Hedtke.
Aquatic Toxicology, Vol. 5, No. 3, p 227-244, 1984. 4 Fig, 6 Tab, 14 Ref.

Descriptors: *Copper, *Ecological effects, *Sediment, *Ecosystems, Water pollution effects, Primary production, Organic carbon, Toxicity, Adaptation.

Laboratory aquatic microcosms were established using natural pond sediment and the organisms contained therein. After a 30-day development time, microcosms were exposed on a flow-through basis to six concentrations of copper with six replicates of each concentration. Measures of energy fixation, material cycling, and biological structure were measured periodically over a 32-wk period. Exposure to copper at 9.3 micro g/l and higher resulted in a change in the structure and function of the test systems while 4.0 micro g/l did not cause an effect relative to controls. Systems at 9.3 micro g/l were structurally similar to controls but at reduced levels of primary production, dissolved organic carbon production, and macroalgal growth. Substantial structural changes occurred at > or = 30 micro g/l as these systems increasingly shifted from autotrophic to heterotrophic systems. Little evidence of adaptation to the copper stress occurred during the test period. (Author's abstract)
W85-02378

EFFECT OF CHRONIC EXPOSURE TO EPN AND TO GUTHION ON THE CRITICAL SWIMMING SPEED AND BRAIN ACETYLCHOLINESTERASE ACTIVITY OF CYPRINODON VARIEGATUS,
Environmental Protection Agency, Gulf Breeze, FL. Gulf Breeze Environmental Research Lab.
G. M. Cripe, L. R. Goodman, and D. J. Hansen.
Aquatic Toxicology, Vol. 5, No. 3, p 255-266, 1984. 1 Fig, 3 Tab, 27 Ref.

Descriptors: *EPN, *Guthion, *Sheepshead minnow, *Pesticide toxicity, *Organophosphorus pesticides, Acetylcholinesterase, Fish behavior, Fish physiology, Pesticides, Water pollution effects.

Swimming performance of the estuarine sheepshead minnow, Cyprinodon variegatus, was measured in a stamina tunnel at the end of life-cycle toxicity tests with the organophosphate pesticides EPN (265 days) and Guthion (219 days). Effects of acetylcholinesterase (AChE) inhibition were also determined. These measures were compared to survival, growth and reproduction data obtained in the life-cycle toxicity test. Significant effects on swimming stamina were detected in fish exposed to 2.2 micro g EPN/L (57% that of control fish) and in fish exposed to 4.1 micro g EPN/L (46% of controls). Survival and growth were reduced only in 7.9 micro g EPN/L. Swimming performance was not affected by Guthion concentrations up to 0.5 micro g/L, a concentration affecting reproduction. AChE was significantly inhibited by all tested concentrations of EPN, 0.25 to 7.9 micro g/L, and Guthion, 0.06 to 0.50 micro g/L. Swimming stamina may be an important endpoint to include with measurements of effects on survival, growth and reproduction in chronic toxicity tests with fish, but the relation of AChE inhibition to these endpoints is uncertain. (Author's abstract)
W85-02379

TOXICITY AND BIOACCUMULATION OF CADMIUM AND COPPER AS AFFECTED BY HUMIC ACID,
Miami Univ., Oxford, OH. Dept. of Zoology.
R. W. Winner.
Aquatic Toxicology, Vol. 5, No. 3, p 267-274, 1984. 2 Fig, 3 Tab, 18 Ref.

Descriptors: *Humic acids, *Cadmium, *Copper, *Toxicity, *Bioaccumulation, Synergistic effects, Daphnia, Water quality criteria, Trace metals, Crustaceans, Bioavailability, Water pollution effects.

The most recent U.S. EPA water quality criteria for cadmium and copper acknowledge that naturally occurring organics will alter toxicity, but no data on the effects of such organics on metal toxicity were available for incorporation into the criteria. The affect of humic acids on bioaccumulation of metals is also poorly documented in the literature. The toxicity of Cd and Cu to daphnids was evaluated over a 42-day exposure period at three humic acid (HA) concentrations. The addition of humic acid to test water decreased the acute and chronic toxicity of Cu but increased the

acute and chronic toxicity of Cd. However, there was no effect of HA on the bioaccumulation of either metal. HA most likely decreased the bioavailability of Cu due to the strong affinity of HA for that metal; the bioavailability of Cd was actually increased as indicated by the impact of HA on Cd toxicity due to the weak affinity of HA for Cd and the ability for Ca to displace Cd. At the highest concentration, the presence of humic acid actually resulted in an increase in mean brood sizes of Cu-exposed animals and prevented a reduction in mean brood sizes of Cd-exposed animals. Bioaccumulation may reflect the physiological condition of the organism more so than the environmental conditions under which exposure occurs. (Collier-IVI)
W85-02380

EFFECTS OF ENVIRONMENTAL CHANGES ON THE FISHERIES AND FISH STOCKS IN THE ARCHIPELAGO SEA AND THE FINNISH PART OF THE GULF OCH BOTHNIA,
Helsinki Univ. (Finland). Dept. of Limnology.
M. Hilden, R. Hudd, and H. Lehtonen.
Aqua Fennica, Vol. 12, p 47-58, 1982. 9 Fig, 3 Tab, 39 Ref.

Descriptors: *Water pollution effects, *Environmental effects, *Gulf of Bothnia, *Finland, *Fisheries, Dam effects, Drainage, Wastewater pollution, Hydrology, Rivers, Spawning, Water quality.

Human activities have affected the fish stocks and fisheries in the Archipelago Sea and the Finnish part of the Gulf of Bothnia. Industrial, domestic and agricultural wastes pollute the coastal areas. Reservoirs with low buffering capacity have waters with very low pH levels. Hydroelectric dams on the rivers draining to the gulf, land drainage, and lumbering have affected the hydrology and water quality of the rivers. The environmental changes caused by man have reduced the possibility of expansion of fisheries by damaging the coastal fisheries. The greatest damage to the fisheries has occurred along the Ostrobothnian coast and has been caused by damage to spawning and nursery areas. To avoid further deleterious effects immediate measures should be taken to protect fish stocks and fishing areas. Where possible, former spawning areas, especially in rivers, should be restored. (Moore-IVI)
W85-02388

STRUCTURE AND DYNAMICS OF ZOOPLANKTON COMMUNITIES, ALLIGATOR RIVERS REGION, N.T., AUSTRALIA,
Esso Australia Ltd., Sydney.
For primary bibliographic entry see Field 2H.
W85-02405

TOXICITY OF ARSENATE AND DDT TO THE CLADOCERAN BOSMINA LONGIROSTRIS,
National Marine Fisheries Service, Ann Arbor, MI. Great Lakes Fishery Lab.
D. R. M. Passino, and A. J. Novak.
Bulletin of Environmental Contamination and Toxicology, Vol. 33, No. 3, p 325-329, September, 1984. 2 Tab, 12 Ref.

Descriptors: *Toxicity, *Arsenic, *Zooplankton, *Bioindicators, Water pollution effects, Great Lakes, Water quality control, Monitoring, DDT, Daphnia.

Acute toxicity to Bosmina longirostris of arsenate and DDT, which are representative inorganic and organic contaminants of the Great Lakes, was sought along with the relative sensitivity of B. longirostris and Daphnia pulex to these contaminants. The mean 96 hr EC50 for B. longirostris was 0.85 mg arsenate/L and the 48 hr EC50 for D. pulex was 49.6 mg arsenate/L. For B. longirostris the difference in 48 hr EC50 values of DDT in the two diluent waters was highly significant. In addition to greater sensitivity of B. longirostris in reconstituted hard water, the results were more reproducible. The difference between 48hr EC50 values for B. longirostris and D. pulex is also highly significant, indicating that the sensitivity of Bosmina exceeds that of D. pulex. Based on the results obtained and the semiautomatic rearing, counting and testing methods used it is concluded that Bosmina longirostris is a suitable zooplankton species for toxicological evaluation of contaminants. (Baker-IVI)
W85-02415

TRICLOPYR TRIETHYLAMINE SALT TOXICITY TO LIFE STAGES OF THE FATHEAD MINNOW (PIMEPHALES PROMELAS RAFINESQUE),
Dow Chemical Co., Midland, MI. Environmental Sciences Research Lab.
M. A. Mayes, D. C. Dill, K. M. Bodner, and C. G. Mendoza.
Bulletin of Environmental Contamination and Toxicology, Vol. 33, No. 3, p 339-347, September, 1984. 3 Tab, 12 Ref.

Descriptors: *Water pollution effects, *Fish, *Toxicity, *Organic compounds, *Herbicides, Agricultural chemicals, Triclopyr, GARLON, Fathead minnows, Immature growth stage.

The study included a 96 hr static acute test, a 192 hr flow-through acute test and a 31 day embryo-larval test. The static acute LC50 and 95% confidence interval (CI) was determined to be 245 (224-269) mg/L; the flow through 96 and 192 hr LC50 values with 95% CI were 120 (104-140) mg/L and 101 (88.5-116) mg/L, respectively. Larval survival varied in the embryo larval tests nonsystematically except at the 114 mg/L level where survival dropped precipitously and was significantly different from the controls. Triclopyr TEA salt appears to be relatively non-toxic to fathead minnows. The concentration of the compound which is toxic to the fathead minnow is well above expected environmental concentrations. Comparison of the acute and embryo-larval toxicity data indicate triclopyr TEA salt has little cummulative or chronic effect on the fathead minnow. (Baker-IVI)
W85-02417

TRACE METAL CONCENTRATIONS IN FISH FROM THE SOUTH ESK RIVER, NORTHEASTERN TASMANIA, AUSTRALIA,
Canberra Coll. of Advanced Education, Belconnen (Australia).
R. H. Norris, and P. S. Lake.
Bulletin of Environmental Contamination and Toxicology, Vol. 33, No. 3, p 348-354, 1984. 3 Tab, 17 Ref.

Descriptors: *Trace metals, *Fish, *South Esk River, *Tasmania, *Australia, *Bioindicators, Copper, Lead, Cadmium, Zinc, Monitoring, Water pollution sources, Mine wastes, Eels, Perch, Tench.

The value of determining metal concentrations in freshwater fish to serve as an indicator of metal pollution was investigated. The South Esk River, the site of the study, is located in northeastern Tasmania and is polluted by cadmium, zinc, lead and copper from Storys Creek and Rossarden mines. Samples were collected at ten sites, 4 above the metal inflow point and 6 below it. A total of 178 fish belonging to five species were collected. Concentrations for all metals in all species were highest in the liver, intermediate in the gills and lowest in the muscle. The short finned eels, Anguilla australis, had significant concentrations of all the metals analyzed at sites both upstream and downstream of the trace metal inflow to the South Esk River. Concentrations of Zn, Cd and Cu in the water clearly indicated elevated levels downstream of site 3. In terms of distribution, the pygmy perch appears to have been the most sensitive to trace metal contamination occurring at uncontaminated upstream sites and at the least contaminated downstream sites. Tench were the least sensitive. The largest tench collected from site 4 had both pectoral fins missing and deformed pelvic and tail fins. The study suggests that waterbody contamination by copper and zinc may not be reflected in concentrations of these metals in fish but that contamination by cadmium may be reflected by cadmium concentration in resident fish. (Baker-IVI)
W85-02418

EFFECT OF SUSPENDED BENTONITE CLAY ON THE ACUTE TOXICITY OF GLYPHOSATE TO DAPHNIA PULEX AND LEMNA MINOR,
Columbia National Fisheries Research Lab., Yankton, SD. Field Research Station.
W. A. Hartman, and D. B. Martin.
Bulletin of Environmental Contamination and Toxicology, Vol. 33, No. 3, p 355-361, September, 1984. 1 Fig, 1 Tab, 14 Ref.

Descriptors: *Pesticides, *Toxicity, *Aquatic life, Water pollution effects, Glyphosate, Organic compounds, Bentonite.

In the Basic Static Test the calculated 48 hr EC50 for Daphnia pulex at 15 C was 3.2 mg/L with suspended sediment and 7.9 mg/L without suspended sediment. Mortality was negligible at about 0.75 mg/L with or without suspended sediment. As concentrations of glyphosate increased, daphnid mortality increased significantly in the presence of suspended sediment. Experiments simulating a single dose of glyphosate to D. pulex populations showed that suspended sediment increased the short term toxicity of glyphosate at all concentrations. In pretreatment cultures, total standing crop of daphnids ranged from 52 to 56/L. One week after the cultures were treated, total population numbers were significantly reduced at all glyphosate concentrations, both with and without suspended sediment. Total standing crops were reduced less in the otherwise equivalent glyphosate solution that lacked suspended sediment. The reduction in all glyphosate treatments was primarily a result of selective toxicity to immature organisms. In the acute toxicity tests conducted with Lemna minor, glyphosate with suspended sediment was clearly less toxic than comparable concentrations of glyphosate alone. Suspended sediment influences the acute toxicity of glyphosate to the organisms tested. (Baker-IVI)
W85-02419

OXYGEN CONSUMPTION BY THE CRAYFISH ORCONECTES PROPINQUUS (GIRARD) EXPOSED TO AQUASHADE,
Indiana Univ.-Purdue Univ. at Indianapolis. Dept. of Biology.
D. F. Spencer.
Bulletin of Environmental Contamination and Toxicology, Vol. 33, No. 3, p 373-378, September, 1984. 3 Fig, 2 Tab, 9 Ref.

Descriptors: *Herbicides, *Dyes, *Toxicity, *Crayfish, Aquashade, Oxygen consumption, Organic compounds, Aquatic plants.

Individual crayfish were placed into 300 ml glass BOD bottles. Tapwater or tapwater treated with 5, 10, or 15 ppm Aquashade was used to fill the bottles. Oxygen consumption rates for individual crayfish exposed to Aquashade were not significantly different from those measured for control organisms. Based on the data presented, Aquashade applied at the recommended rate of 1 ppm should not significantly alter oxygen uptake rates of crayfish. While the dyes used in Aquashade have been judged to be safe based on feeding tests with rats, mice, and dogs, this is the first published report which suggests that Aquashade does not adversely affect common aquatic invertebrates. (Baker-IVI)
W85-02420

TOXICITY OF FENITROTHION TO FATHEAD MINNOWS (PIMEPHALES PROMELAS) AND ALTERNATIVE EXPOSURE DURATION STUDIES WITH FENITROTHION AND ENDOSULFAN,
Environmental Research Lab.-Duluth, MN.
C. F. Kleiner, R. L. Anderson, and D. K. Tanner.
Archives of Environmental Contamination and Toxicology, Vol. 13, No. 5, p 573-578, September, 1984. 3 Tab, 19 Ref.

Descriptors: *Pesticides, *Toxicity, *Fish, Organic compounds, Minnows, Water pollution effects, Fenitrothion, Endosulfan.

The toxic effects of fenitrothion to fathead minnows was investigated along with the effects of

short-term exposures of fenitrothion and endosulfan on this species. Survival of fathead minnows was significantly reduced at 0.86 and 0.74 mg/L during two 14 day embryo-larvae studies. In a 30 day embryo-larvae study, growth was not adversely affected at 0.13 mg/L. Significant differences occurred at 0.30 mg/L. Growth differences were more significant than survival. A 96 hr acute value for endosulfan was 1.32 micro g/L which agrees with published values. No delayed mortality was noted in this study. (Baker-IVI)
W85-02421

FATE OF FENITROTHION IN SEVERAL DEVELOPMENTAL STAGES OF THE KILLIFISH (ORYZIAS LATIPES),
Sumitomo Chemical Co. Ltd., Takarazuka (Japan). Research Center.
Y. Takimoto, M. Ohshima, H. Yamada, and J. Miyamoto.
Archives of Environmental Contamination and Toxicology, Vol. 13, No. 5, p 579-587, September, 1984. 4 Fig, 3 Tab, 18 Ref.

Descriptors: *Insecticide, *Toxicity, *Killifish, *Fenitrothion, Organic compounds, Bioaccumulation, Agricultural chemicals, Water pollution effects, Growth stages, Fish.

Short term exposure of 0.1 ppm nominal concentration of fenitrothion to five different developmental stages of killifish was carried out by a flow-through system to measure the bioaccumulation potential at each stage and also the transference to eggs from parent animals of decomposition products as well as the parent compound. Thereafter the organisms were transfered to fresh water to measure the biodegradability and excretion potential of the compounds produced during the exposure period. Fenitrothion was rapidly absorbed at each stage of the killifish, with concentrations in organisms reaching equilibrium after 1 to 3 days of exposure except for the juvenile stage which shows a gradual increase in concentration. The maximum bioaccumulation ratios of the parent compound ranged from 88 to 540-fold relative to the water concentration. Demethylfenitrothion and 3-methyl-4-nitrophenyl-beta-glucuronide are produced at all stages except the embryo, and the highest content of the former compound is produced at the yolk sac fry stage. Once placed in fresh water, the fenitrothion concentrations decreased rapidly with a variation of the half life of the parent compound from 0.27 day (yolk sac fry) to 1.42 days (embryo). Primary distribution of the compounds is in the internal organs, with concentration occurring in the mature eggs present in the female body as well. (Baker-IVI)
W85-02422

ACUTE AND CHRONIC TOXICITIES OF ARSENIC(III) TO FATHEAD MINNOWS, FLAGFISH, DAPHNIDS, AND AN AMPHIPOD,
A. R. Lima, C. Curtis, D. E. Hammermeister, T. P. Markee, and C. E. Northcott.
Archives of Environmental Contamination and Toxicology, Vol. 13, No. 5, p 595-601, September, 1984. 5 Tab, 21 Ref.

Descriptors: *Fish, *Toxicity, *Arsenic, *Water pollution effects, Industrial wastes, Fathead minnows, Flagfish, Daphnia, Mortality.

Acute exposure of fathead minnows to As resulted in some deaths at the two highest exposure concentrations (52,100 and 99,700 micro g/L) within two hr of initial exposure. No fish survived 96 hr exposures greater than 25,000 micro g/L. All fish survived exposures of less than 5,060 micro g/L. Only one fish survived 96 hr exposure to concentrations greater than 25,900 micro g/L. Acute exposure of amphipods to As resulted in some immobilization at the two highest exposures (2,400 and 5,250 micro g/L) within 19 hr of initial exposure. All test organisms became affected at concentrations greater than 1,340 micro g/L after 96 hr of exposure and only one organism was immobilized at concentrations less than 583 micro g/L. Unfed daphnids exposed to As responded quickly with most of the effects occurring within 24 hr of initial exposure. No organisms survived exposure to concentrations greater than 4,190 micro g/L. After 48 hr of exposure to As, only a single organism was distressed at concentrations less than 2,220 micro g/L, and this was not caused by As exposure. Chronic exposures of 28 to 31 days duration were made for fathead minnows, flagfish and daphnids. The chronic limit ranges based on the most sensitive measured parameters of body length and wet weight were 2,130 to 4,300 micro g/L for flathead minnows, and 2,130 to 4,120 micro g/L for flagfish. Daphnids had chronic limits of 633 to 1,320 micro g/L based on survival and the measured parameters of reproduction and body length. Calculation of an acute test/chronic test ratio for fathead minnows, flagfish, and daphnids resulted in a range of values from 1.64 to 4.80. (Baker-IVI)
W85-02423

ROLE OF BENTHIC FILMS IN THE OXYGEN BALANCE IN AN EAST DEVON RIVER,
Exeter Univ. (England). Dept. of Chemical Engineering.
J. D. Boyle, and J. A. Scott.
Water Research, Vol. 18, No. 9, p 1089-1099, 1984. 10 Fig, 8 Tab, 11 Ref.

Descriptors: *Biochemical oxygen demand, *Rivers, *Benthic environment *Films, *Devon, *England, Respiration, Oxygen balance, Pulp and paper industry, Industrial wastes, Decomposition.

A method for the direct assessment of the rates of the main processes involved in the oxygen balance of a shallow (0.6 m) Devon river is described and an oxygen balance over a stretch of the stream is demonstrated. The river receives effluent from a papermill. Benthic respiration dominates the oxygen balance in the stretch most affected by the effluent and increases the effective biochemical oxygen demand decomposition rate by a factor of up to 12. Values of decomposition rates of 3.5 to 4.5/day have been measured in the stream. Although increasing river flow rate is likely to increase the dilution of bacteria suspended in the stream and therefore to decrease the oxygen uptake in a given parcel of water, the same number of bacteria may pass a given point during a given time interval independent of flow rate. The effect of different depths of water can also be considered. If it is assumed that the bacterial concentration support in a film is independent of river depth, then the effect of the respiration of the film-bacteria on the rate of decline of oxygen concentration in the water above them will be inversely proportional to depth. Benthic (film) processes are of most significance in shallow rivers, and in rivers where a given area of river bottom can maintain a high surface area of film. (Baker-IVI)
W85-02426

GROWTH INHIBITION OF PLANKTONIC ALGAE DUE TO SURFACTANTS USED IN WASHING AGENTS,
National Inst. for Environmental Studies, Tsukuba (Japan). Lab. of Freshwater Environment.
A. N. Yamane, M. Okada, and R. Sudo.
Water Research, Vol. 18, No. 9, p 1101-1105, 1984. 3 Fig, 3 Tab, 20 Ref.

Descriptors: *Surfactants, *Detergents, *Algal growth, *Water pollution effects, Soap, Selenastrum, Nitzschia, Microcystis, Domestic wastes, Soaps.

The inhibitory effects on freshwater plankton algae of synthetic surfactants and soaps that are widely used in laundry detergents as raw materials were investigated. Five types of anionic surfactants including a soap and three types of nonionic surfactants were tested. A green alga Selenastrum capricornutum, a blue-green alga Microcystis aeruginosa and a diatom Nitzschia fonticola were chosen as test organisms. Surfactants used included sodium alkylbenzenesulfonate (LAS), sodium alkyl sulfate (AS), sodium polyoxyethylene alkyl ether sulfate (AES), sodium alphaolefinsulfonate (AOS) and soap. Also used were three surfactants of the polyoxyethylene alkyl ether type, EO:4, EO:9, and EO:13 and two surfactants of the polyoxyethylene alkylphenyl ether (APE) type, Emulgen 909 and Emulgen 910. The EC50 value of LAS ascertained for S. capricornutum fell between 50 and 100 mg/l. The values of EC50 for polyoxyethylene alkyl ether (AE) ranged from 2 to 10 mg/l. Those for APE and sugar esters ranged from 20-50 mg/l and from 8 to 12 mg/l, respectively. APE showed lower toxicity than AE in this study. The EC50 values for AS, AES, and AOS fell between 45-64 mg/l. Those for LAS and soap were between 50 and 100 mg/l and between 10 and 50 mg/l, respectively. The most sensitive algae for a specific surfactant was not always the most sensitive one for other surfactants. The effects of surfactants on algae must be regarded as being species specific. (Baker-IVI)
W85-02427

AQUATIC CONTAMINATION AND ECOLOGICAL RISK. AN ATTEMPT TO A CONCEPTUAL FRAMEWORK,
National Swedish Environment Protection Board, Uppsala (Sweden). Water Quality Lab.
L. Hakanson.
Water Research, Vol. 18, No. 9, p 1107-1118, 1984. 5 Fig, 6 Tab, 20 Ref.

Descriptors: *Water pollution effects, *Model studies, *Toxicity, *Sediments, Mercury, Metals, Contamination, Ecotoxicology.

A conceptual model is presented concerning the causal relationships determining the relationship between dose and response of toxic substances in aquatic environments. Mercury is used as the test element. Special emphasis is placed on environmental factors which regulate the potential effects of the contaminant and stresses the importance of sedimentology in ecotoxicology. Ecological effect, dose and sensitivity are included. In order to prepare a potential ecological risk index for use in practical environmental control work, the index must be based on tested and comparatively inexpensive standard methods. Specifics which must be accounted for in the index include biological contact area, biological contact time, and additive effects. The residual term is also a significant fundamental concept and it describes the fact that it is impossible in ecological contexts to reach a complete understanding of a relationship. (Baker-IVI)
W85-02428

FLUORIDE CONTENT OF DRINKING WATER AND THE MENARCHEAL AGE,
Jozsef Attila Univ., Szeged (Hungary). Dept. of Anthropology.
Gy. Farkas, A. Fazekas, and E. Szekeres.
Acta Biologica (Nova Series), Vol. 29, No. 1-4, p 159-167, 1983. 5 Tab, 37 Ref.

Descriptors: *Drinking water, *Fluoridation, *Public health, *Hungary, Humans, Fluorides, Water treatment.

In case the long standing consumption of the daily fluoride content optimal for the viewpoint of caries prevention would harmfully influence the normal physiological processes of the human organism, a study was carried out on the somatic maturity of school-aged children from two Hungarian settlements where the fluoride concentration of the drinking water showed significant variations, (1.09 mg/l vs. 0.17 mg/l). Inquires were made concerning the time of the first menstruation in the case of 337 girls in Kunszentmarton and 467 girls in Kiskunmajsa. Even though there is more than a 6-fold difference in the fluoride content of drinking water, there are no essential changes observed in the age at puberty of the girls. This supports the presumption that the optimal intake of fluoride for caries prevention does not show any effect on the puberty age. (Baker-IVI)
W85-02475

ARTIFICIAL SUBSTRATES WHICH RELEASE NUTRIENTS: EFFECTS ON PERIPHYTON AND INVERTEBRATE SUCCESSION,
Central Michigan Univ., Mount Pleasant. Dept. of Biology.
G. W. Fairchild, and R. L. Lowe.
Hydrobiologia, Vol. 114, No. 1, p 29-37, July, 1984. 4 Fig, 56 Ref.

Descriptors: *Nutrients, *Periphyton, *Invertebrates, Phosphate, Nitrate, Chlorophyll, Succession, Artificial substrate, Algae, Midges, Mollusks, Crustacea.

Nutrient diffusing substrates for periphyton were made from clay flower pots, sealed with plastic petri dishes, and filled with 2% agar and specified nutrients. When placed in water, the nutrients slowly diffuse through the agar and clay walls of the pots, becoming available to organisms colonizing the outer surface. Forty-eight pots, 16 containing 0.1 M KH2PO4, 16 with 0.1 M NaNO3 and 16 with no added nutrients were placed af 0.5 m depth in Douglas Lake, Michigan. Four pots of each nutrient treatment were sampled for algal periphyton and invertebrates after 7, 14, 25, and 36 days. A total of 72 algal species were enumerated. Most true phytoplankton reached the pots rapidly, but experienced little benthic growth. Invertebrates which colonized the pots were present in the sediments and upon nearby vegetation, and arrival on the pots probably involved primarily substrate-associated movement or weak swimming over short distances. Chironomids, chydorid Cladocera, and gastropods dominated the invertebrate fauna found on the pots. The study provided little evidence of competitive effects exerted by the dominant species upon other taxa. (Baker-IVI)
W85-02479

EFFECTS OF LOW-PH STRESS ON THE MORPHOLOGY AND ACTIVITY OF BACTERIA FROM LAKES RECEIVING ACID PRECIPITATION,
National Water Research Inst., Burlington (Ontario).
S. S. Rao, D. Paolini, and G. G. Leppard.
Hydrobiologia, Vol. 114, No. 2, p 115-121, July, 1984. 4 Fig, 2 Tab, 12 Ref.

Descriptors: *Acidity, *Bacteria, *Acid lakes, *Acid rain, Water pollution effects, Morphology, Bioindicators, McFarlane Lake, Silver Lake, Ontario.

Field and laboratory studies on the effects of low-pH stress are reported here for lacustrine bacteria. Sediment cores examined were collected from acid stressed Silver Lake and non-acid stressed McFarlane Lake near Sudbury, Ontario. Bacterial populations stressed in laboratory ecosystems were affected in their cytological characteristics, their cell densities and their physiological activity. The greatest complexity in terms of their diversity, cell structure and development of extracellular product is found at pH 5.0. Among the extracellular materials associated with the cell surface, fibrils and granules were particularly abundant with a characteristic type of granule often found on cells of mixed populations at the interface between the cell wall and the aquatic milieu as a cell bound material. In addition, low pH stress appears to have a marked effect on the bacterial morphology per se and/or the selection of dominant cell types. It is conceivable that the pH stress-related cell surface changes reported may reflect a basis for the selection of low pH-resistant microbes whose survival is dependent on physiological adjustments including an extremely low metabolism. The morphological differences in cells under extreme environmental stress may be significant as stress indicators if related to cell surface exchange and/or membrane permeability properties associated with nutrient transport or transport of toxic substances in acidified lakes. (Baker-IVI)
W85-02482

LONG-TERM CHANGES OF THE SUBMERGED MACROPHYTES IN EUTROPHIC LAKE MIKOLAJSKIE (NORTH POLAND),
Warsaw Univ. (Poland). Dept. of Hydrobiology.
T. Ozimek, and A. Kowalczewski.
Aquatic Botany, Vol. 19, p. 1-11, 1984. 4 Fig, 4 Tab, 24 Ref.

Descriptors: *Macrophytes, *Eutrophication, *Lake Mikolajskie, *Poland, Distribution, Frequency, Littoral zone, Aquatic plants, Depth, Biomass.

On the basis of quantitative observations of submerged macrophytes over the past 17 years, it has been found that their distribution, frequency and presence in Lake Mikolajskie are all affected by eutrophication. The area occupied by the submerged macrophytes in the lake was about 44 ha in 1971. In the 9 year period to 1980, this decreased by about 14 ha (30%). In 1971 the macrophytes drew down to a depth of 5.5 m, reached their highest frequency at a depth of 2.0 m, and were found only sporadically at 4.5-5.5 m. In 1980 they occurred only to a depth of 3.5 m. The highest (21%) frequency depth had decreased to 1.5 m and was only slightly higher than those determined for 0.5 and 2.0 m depths. Comparison of the two sets of data shows a 5-fold rise in macrophyte frequency at a depth of 0.5 m, similar values at depths of 1.0 and 1.5 m, and a small but consistent decrease of frequency values below 2.0 m in 1980 as compared with 1971. The maximum value did not change much, being 30% in 1971 and 21% in 1980. The aquatic macrophyte species present in the lake did not change significantly during this period of time. There were considerable changes in the frequency of occurrence of certain taxa. The contribution of particular taxa to the total biomass changed considerably. The greatest decrease was observed for the percentage contributions of Characeae and Ceratophyllum demersum (18%) and the greatest increase was for Potamogeton pectinatus (0.3% in 1971 to 19.0% in 1980). The biomass of all macrophytes at each depth decreased. (Baker-IVI)
W85-02483

DETERMINATION OF THE TROPHIC STATE OF LAKE TRASIMENO BY INDIRECT ANALYSIS OF NITROGEN AND PHOSPHORUS (DETERMINAZIONE DELLO STATO TROFICO DEL LAGO TRASIMENO ATTRAVERSO LA VALUTAZIONE INDIRETTA DELL'AZOTO E DEL FOSFORO),
Perugia Univ. (Italy). Ist. di Idrobiologia e Pescicultura.
M. Mearelli, M. Lorenzoni, and F. Ruffini.
Rivista di Idrobiologia, Vol. 20, No. 3, p 571-587, 1981. 2 Fig, 3 Tab, 15 Ref.

Descriptors: *Nitrogen, *Phosphorus, *Lake Trasimeno, *Italy, *Eutrophication, Agricultural wastes, Domestic wastewater, Water pollution control, Water pollution sources.

Indirect analysis of nitrogen and phosphorus loading relative to the lake Trasimeno basin, was carried out in an attempt to define its present trophic state. Loading was estimated and evaluated using two models of Vollenweider. The results obtained showed that the greatest fraction of nitrogen is discharged by agricultural activity, while that of phosphorus is due to input of domestic waste. On the basis of this results, various hypotheses for intervention have been prospected which aim at reducing the present state of eutrophication. (Author's abstract)
W85-02497

EFFECTS OF COPPER POLLUTION ON ICTALURUS NEBULOSUS (EFFETTI DELL'INQUINAMENTO DA RAME SU ICTALURUS NEBULOSUS),
Modena Univ. (Italy). Ist. di Anatomia Comparata.
I. Benedetti, L. Benedetti, A. M. Bolognani Fantin, M. Marini, and E. Ottaviani.
Rivista di Idrobiologia, Vol. 20, No. 3, p 611-620, 1981. 6 Fig, 2 Tab, 17 Ref.

Descriptors: *Copper, *Fish, *Toxicity, *Water pollution effects, Heavy metals, Liver, Integument, Intestine, Food habits.

The copper concentration in tissues of specimens of Ictalurus nebulosus, fished from a canal in which the deposits and vegetation showed a high content of this metal, above the standard value, especially in the liver and in the gut. The high copper content found in the gut of this teleost is due to its feeding habits and to the presence of this metal in the environment. The copper is absorbed with the food through the intestinal walls without damaging them and accumulates in the liver. The increase of copper in the liver produces cytoplasmic vacuolization in the hepatocytes and a noticeable depletion of the proteins; in some areas picnotic nuclei are evident. The integument shows a remarkable decrease of the mucous and club cells and degenerative patterns in the principal cells. The hypothesis that the damage to the integument is a consequence of hepatic injury is put forward. (Author's abstract)
W85-02498

HYDROBIOLOGICAL RESEARCH ON TWO SMALL BRACKISH LAKES IN PORTONOVO; I: LAKE PROFONDO (RICERCHE IDROBIOLOGICHE SU DUE LAGHETTI DI PORTONOVO; PARTE I: LAGO PROFONDO),
Perugia Univ. (Italy). Ist. di Idrobiologia e Pescicultura.
L. Mantilacci.
Rivista di Idrobiologia, Vol. 20, No. 3, p 621-643, 1981. 2 Fig, 4 Tab, 18 Ref.

Descriptors: *Saline lakes, *Portonovo, *Italy, *Water pollution effects, Environmental effects, Plankton, Eutrophication, Coastal areas, Land development, Lake shores.

Hydrobiological research was carried out during the years 1980, 1981, 1982, on 11 samples in a salt lake in Portonovo (Ancona, Italy), in order to ascertain the enviromental situation following alterations to the coastline which is being built up as seaside resorts. Two sampling points were chosen: Station 1 and Station 2; the first situated in the center of the lake and the second along the lake shore or neritic zone. Research consisted in physical-chemical observations and qualitative-quantitative analysis of the plankton population; a saprobic index of the lake was calculated. The results obtained show a rather critical environmental situation. (Author's abstract)
W85-02499

HYDROBIOLOGICAL RESEARCH ON TWO SMALL BRACKISH LAKES IN PORTONOVO; II: LAKE GRANDE (RICERCHE IDROBIOLOGICHE SU DUE LAGHETTI DI PORTONOVO; PARTE II: LAGO GRANDE),
Perugia Univ. (Italy). Ist. di Idrobiologia e Pescicultura.
L. Mantilacci.
Rivista di Idrobiologia, Vol. 20, No. 3, p 645-659, 1981. 1 Fig, 5 Tab, 18 Ref.

Descriptors: *Lake Grande, *Italy, *Brackish lakes, *Water pollution effects, Plankton, Environmental effects, Eutrophication.

Research was carried out on Lake Grande, a brackish ecosystem situated in Portonovo (Ancona, Italy), in order to bring to light any possible modifications to the environment following large-scale intervention by man. Seasonal sampling was taken during 1981-1982 and both physical-chemical data and plankton were collected. Furthermore, a qualitative evaluation of the lake waters was carried out on the basis of information gleaned from each species, according to the system of Sladecek (Archiv. Hydrob., 7, 1-218, 1973) and an attempt was made to quantify the saprobity of the lake with the calculation of a 'Saprobic index' according to the model of Pantle and Buck (Gass und Wasserfach., 96, 604, 1955) corrected by Descy (Utilisation des algues benthiques comme indicateurs biologique de la qualite des eaux courantes. La pollution des eaux continentales. Incidence sur les biocenoses aquatiques. Gauthier-Villars E., Bordas, 1976). The results obtained show a somewhat degraded environment. (Author's abstract)
W85-02500

CONCENTRATIONS OF CADMIUM AND LEAD IN THE BODY OF SOME MACROBENTHOS SPECIES FROM FIVE STREAMS OF SOUTHERN POLAND,
Jagiellonian Univ., Krakow (Poland). Dept. of Hydrobiology.
K. Jop, and K. Wojtan.
Acta Hydrobiologica, Vol. 24, No. 3, p 197-210, 1982. 4 Fig, 4 Tab, 21 Ref.

Descriptors: *Water pollution effects, *Heavy metals, *Invertebrates, *Poland, Cadmium, Lead, Bioaccumulation, Calcium.

Concentrations of lead and cadmium in the body of some abundant macroinvertebrates from the three taxonomic groups were investigated and compared with concentrations of these elements in water and sediments in some streams contaminated by the pollution in Southern Poland. Investigations were carried out in the catchment basin of the Drwinka stream in the vicinity of Kracow and the catchment basin of the Biala Przemsza River flowing across the Kracow-Czestochowa Jura. Concentrations of metals decreased with increasing age in all species studied. The relationships of metal concentrations in aquatic invertebrates were not consistent with the degree of contamination in streams. Calcium concentration of stream waters appeared to affect body metal concentration. (Baker-IVI)
W85-02509

EFFECTS OF EXPLORATION OF THE 'ZARABIE' BATH ON THE WATER QUALITY OF THE RIVER RABA (SOUTH POLAND),
Instytut Ksztaltowania Srodowiska, Krakow (Poland).
K. Stachowicz, and M. Czernoch.
Acta Hydrobiologica, Vol. 24, No. 3, p 211-222, 1982. 4 Fig, 3 Tab, 10 Ref.

Descriptors: *Water quality, *Swimming, *River Raba, *Poland, *Bacteria, *Public health, Zarabie Territory, Drinking water, Water pollution sources, Recreation, Physicochemical properties.

The extent to which bathing at Zarabie affects the quality of the waters of the River Raba was investigated. The problem is important in that River Raba is a source of drinking water for the town of Myslenice and the city of Kracow. The River Raba, which flows across the recreational area of Zarabie, is dammed up by a weir. The best bathing conditions are just below the weir where there is usually the greatest crowd of bathers every Sunday. When the number of bathers below the weir was about 20, no significant changes in water quality were found in the 14 environmental parameters analyzed. When there were more than 30 bathers in the water, negative changes in the bacteriological indices were recorded and at a still greater number, changes were noted in the physicochemical parameters as well. Seston analyses showed a three times increase in the number of organisms during intensive bathing periods. The range of the negative effect of bathing on water quality was noted for a distance of 2.5 km along the river. (Baker-IVI)
W85-02510

EFFECT OF SUSPENDED MATERIALS ON ZOOPLANKTON, 2. LABORATORY INVESTIGATIONS OF DAPHNIA HYALINA LEYDIG,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
R. Zurek.
Acta Hydrobiologia, Vol. 24, No. 3, p 233-251, 1982. 11 Fig, 3 Tab, 24 Ref.

Descriptors: *Suspended load, *Zooplankton, *Water pollution effects, *Daphnia, *Population dynamics, Behavior, Turbidity, Bottom sediments, Algae, Clay, Suspended solids.

Experiments were carried out for the purpose of elucidating some aspects of relations between planktonic animals and suspensions. Daphnia hyalina populations were cultivated in three kinds of turbid medium: suspension of bottom sediments, bentonite and red loam with a high content of clay minerals. Two concentrations of green alga were combined with the turbid mediums. Ingested mineral suspension caused the increase in specific gravity and, as a result, in the velocity of sinking. The frequency of antenna beats increased by 13%. In concentrations greater than and equal to 100 mg/cu dm of suspensoids the respiration of D. hyalina was 10.6 to 32.4% higher, in dependence on Daphnia length. The influence of suspension depended both on the kind of suspension and the time of exposure. (Baker-IVI)
W85-02511

STREAM ECOSYSTEMS IN MOUNTAIN GRASSLAND (WEST CARPATHIANS); 5. BACTERIA,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
For primary bibliographic entry see Field 5B.
W85-02516

STREAM ECOSYSTEMS IN MOUNTAIN GRASSLAND (WEST CARPATHIANS); 6. SESSILE ALGAE COMMUNITIES,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
For primary bibliographic entry see Field 5B.
W85-02517

STREAM ECOSYSTEMS IN MOUNTAIN GRASSLAND (WEST CARPATHIANS); 9. OLIGOCHAETA,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
For primary bibliographic entry see Field 5B.
W85-02520

STREAM ECOSYSTEMS IN MOUNTAIN GRASSLAND (WEST CARPATHIANS); 12. GENERAL CONCLUSION,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
For primary bibliographic entry see Field 5B.
W85-02521

EPIPELIC ALGAE IN MARGINAL PARTS OF THE PRZECZYCE RESERVOIR AND OF NEIGHBOURING SECTORS OF THE RIVER CZARNA PRZEMSZA (UPPER SILESIA); 1. ALGAE IN CONSTANTLY SUBMERGED ZONE,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
For primary bibliographic entry see Field 2H.
W85-02522

QUANTITATIVE INVESTIGATIONS ON ODONATA, HETEROPTERA AND COLEOPTERA IN A DRAINAGE CHANNEL NEAR THE VILLAGE OF TUREW (POZNAN REGION),
Polish Academy of Sciences, Poznan. Dept. of Agrobiology and Forestry.
For primary bibliographic entry see Field 5B.
W85-02523

EFFECT OF SEWAGE REMOVAL ON LAKE WATER QUALITY (FUSCHLSEE, SALZBURG, AUSTRIA),
Paracelsus-Forschungsinstitut, Salzburg (Austria).
J. Haslauer, Jr., O. Moog, and M. Pum.
Archiv fur Hydrobiologie, Vol. 101, No. 1/2, p 113-134, 1984. 7 Fig, 10 Tab, 55 Ref.

Descriptors: *Water pollution effects, *Wastewater disposal, *Lake Fuschl, *Austria, Eutrophication, Oligotrophication, Phosphorus, Nutrients, Dissolved oxgyen, Crustacean, Stagnation, Seasonal variation.

Lake Fuschl, a formerly oligotrophic lake, has shown characteristics of cultural eutrophication since 1966. Beginning in 1971, Oscillatoria rubescens blooms appeared annually and the hypolimnetic oxygen content decreased steadily. From 1972 to 1982 the nutrient supply of domestic waste water to Lake Fuschl was reduced ultimately to 77% after a sewage collection system with a tertiary treatment plant outside of the catchment area began operation. Distinct signs of reoligotrophication have been noted in the lake. The average total phosphorus concentration sank from 56 to 14 mg/cu m and the mean Secchi-depth increased from 4.7 to 7.4 m. Since 1980 oxygen was detected again on the lake bottom at the end of summer stagnation. The chlorophyll-a concentration exhibited a reduction from 5.2 to 1.4 mg/cu m, and the mean clutch size of the dominant planktonic crustacean, Eudiaptomus graciis, sank from 9.7 to 6.9. Loading calculations indicated that the sewage removal caused a total phosphorus load lower than the permissable loading of earlier studies. (Baker-IVI)
W85-02525

DEVELOPMENT OF OXYGEN CONDITIONS IN LAKE ZURICH FROM 1936 TO 1982 (ENTWICKLUNG DER SAUERSTOFFVERHALTNISSE IM ZURICH-OBERSEE UND IM ZURICH-UNTERSEE VON 1936 BIS 1982),
Zurich Univ., Kilchberg (Swizerland). Hydrobiological-Limnological Station.
For primary bibliographic entry see Field 2H.
W85-02529

EFFECT OF WOOD WASTE DUMPING ON ORGANIC MATTER IN SEAWATER AND SURFICIAL SEDIMENTS OF ALBERNI INLET, BRITISH COLUMBIA,
ISK Environmental Research, Saanichton (British Columbia).
K. Iseki, R. W. Macdonald, and C. S. Wong.
Journal of the Oceanographical Society of Japan, Vol. 40, p 213-220, 1984. 6 Fig, 22 Ref.

Descriptors: *Organic matter, *Wood, *Pulp wastes, *Seawater, *Sediments, *Alberni Inlet, *British Columbia, Water pollution effects, Particulates, Dissolved solids, Organic carbon, Spoil banks.

Distribution of particulate organic carbon (POC) and dissolved organic carbon (DOC) in seawater, and chemical composition of surficial sediments were studied in relation to pulpmill effluent and dumping of dredge spoil containing wood debris in Alberni Inlet, British Columbia, Canada. The maximum concentration of POC (377-584 micro g C/l) was observed at the surface around the dumping area (5-7 km seaward of the inlet's head), and at the location immediately adjacent to the dump site POC was elevated throughout the water column (50 m). While POC tended to decrease in the surface layer for a distance of about 25 km down-inlet, measureable effects of POC in the deeper water did not extend beyond 600 m from the dump site. The dump site was conspicuous by the large maximum in C:N ratio (46.3). In contrast, DOC was observed to be highest (4.25 mg C/l) at the head of the inlet where pulpmill effluent was being discharged and a secondary maximum was found about 10 km down-inlet from the dump site. The data suggest that a considerable proportion of the dredge spoil sinks rapidly near the dump site, probably within several hundred meters. Some of the spoil, perhaps low density wood debris may travel considerably further with the surface water where by leaching it may contribute to some extent to the surface DOC before sinking into deeper water. (Author's abstract)
W85-02533

ECOLOGICAL EFFECTS OF ACID DEPOSITION UPON PEATLANDS: A NEGLECTED FIELD IN 'ACID-RAIN' RESEARCH,
Minnesota Univ., Minneapolis. Dept. of Ecology and Behavioral Biology.
E. Gorham, S. E. Bayley, and D. W. Schindler.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 41, No. 8, p 1256-1268, August, 1984. 3 Fig, 2 Tab, 135 Ref.

Descriptors: *Peatlands, *Acid rain, *Water pollution effects, Wetlands, Research priorities, Bogs, Fens, Acidification, Drainage, Streams, Lakes, Biogeochemistry.

Certain types of peatlands are probably highly susceptible to anthropogenic acidification, yet very little research is being done on the vulnerability of bogs and fens to acid deposition. The need for such research and for studies of the role of acidification - natural and anthropogenic in determining nutrient availability, metal mobilization, and biogeochemical cycling by fauna and microflora has been documented. Possible effects of hydrological changes, and of drainage from acid peatlands to lakes and streams, are noted. An outline is provided of possible responses of plants and animals to acidification; these should be investigated at species, community, and ecosystem levels. Studies of

peatlands as possible sources of the gaseous precursors of acid deposition are needed. Different approaches to examining the responses of peatlands to acid deposition include geographical surveys, experimental studies, short-term, long-term, and paleoecological investigations, and analysis of biogeochemical mass-balances. Finally, the need for inclusive studies of peatlands in relation to surrounding uplands and to the streams and lakes that receive their drainage is emphasized. (Author's abstract)
W85-02536

REMARKS ON THE STRUCTURE OF ZOOPLANKTONIC POPULATIONS IN THE SEWAGE DISCHARGE ZONE OF MARSEILLE-CORTIOU (REMARQUES SUR LA STRUCTURATION DES POPULATIONS ZOOPLANCTONIQUES DANS LA ZONE DE L'EMISSAIRE DE MARSEILLE-CORTIOU),
Endoume Marine Station and Oceanography Centre, Marseille (France).
G. Patriti.
Marine Biology, Vol. 82, No. 2, p 157-166, August, 1984. 12 Fig, 14 Ref.

Descriptors: *Zooplankton, *Wastewater pollution, *Marseille, *France, Population dynamics, Species diversity, Effluents, Seasonal variation, Wind, Waves.

The impact of a polluted water-layer on zooplanktonic populations was studied in the sewage discharge zone at Marseille-Cortiou throughout 1977 and a modification of specific diversity was observed: diversity was instable near the outfall, but increased slightly and became more stable further away in non-polluted stations. The population composition did not seem to change. Species rank varied slightly and the number of species increased with increasing distance from the outfall. Specific 'dominance' remained relatively unchanged, and essentially consisted of only 5 species: Clausocalanus acuicornis, Evadne spinifera, Oithona helgolandica, Temora stylifera and Centropages typicus. The population structure, as illustrated by 'Frontier' diagrams, was higher during or just preceding winter. Population organization was the same close to or far away from the outfall, although the total population counts and number of species were smaller at the most polluted stations. The taxons exhibiting the largest decreases in density were: euphausids, nauplii, larvae of various brachyurans and gastropods, fish eggs, the pteropod Cavolinia inflexa, the copepod Calanus minor and several Coryceidae. The greatest disturbance of the population structure at all stations was observed during the summer. The composition of the zooplanktonic population seems to depend much more on seasonal factors than on the level of pollution. It was not possible to distinguish a cluster of species which were sufficiently dominant to be considered as really characteristic; perhaps the rather high exposure of the sewage site to winds and waves prevents the formation of a local facies. (Author's abstract)
W85-02537

ACCUMULATION OF CADMIUM FROM CONTAMINATED WATER AND SEDIMENT BY THE SHRIMP CALLIANASSA AUSTRALIENSIS,
Australian Atomic Energy Commission, Sutherland. Lucas Heights Research Labs.
M. Ahsanullah, M. C. Mobley, and D. S. Negilski.
Marine Biology, Vol. 82, No. 3, p 191-197, August, 1984. 4 Tab, 23 Ref.

Descriptors: *Cadmium, *Shrimp, *Water pollution effects, *Sediment contamination, Heavy metals, Toxicity, Marine environment.

The burrowing marine shrimp Callianassa australiensis (Dana) was collected from an uncontaminated area in Western Port, Victoria, Australia in 1977. The shrimp were exposed to cadmium-contaminated water and sediment for 8 wk. The concentrations ranged from 0.5 to 63 micro g Cd/l for water and 0.5 to 63 micro g Cd/g for sediment. The shrimp accumulated cadmium from water at a rate commensurate with increases in the concentration of cadmium in water and the duration of the experiment. Although the cadmium concentration in the sediments was 1000 times higher than that in water, it had no effect on cadmium uptake by the shrimp. The concentration factors decreased with increasing concentration of cadmium in water but increased as the duration of exposure increased. The shrimp dry weight decreased with increasing concentration of cadmium in water and duration of exposure. As was the case with cadmium uptake by the shrimp, these two factors acted interactively on the shrimp dry weight, but the third factor, concentration of cadmium in sediment, had no effect. (Author's abstract)
W85-02538

EFFECTS OF METALS ON NITROGEN FIXATION AND DENITRIFICATION IN SLURRIES OF ANOXIC SALTMARSH SEDIMENT,
State Univ. of New York at Stony Brook. Marine Sciences Research Center.
J. Slater, and D. G. Capone.
Marine Ecology Progress Series, Vol. 18, No. 1-2, p 89-95, June, 1984. 4 Fig, 2 Tab, 42 Ref. EPA grant R-809475-01-0, Hudson River Foundation grant 14-83B-12, NSF grant OCE-82-00157, NOAA grant NA-80-RAD-0057.

Descriptors: *Metals, *Nitrogen fixation, *Denitrification, *Sediments, *Salt marshes, *Anoxic conditions, Mercury, Lead, Cadmium, Zinc, Copper, Chromium, Molybdenum, Water pollution effects.

The effect of metals on nitrogen fixation, as measured by acetylene reduction, and on denitrification, as determined by nitrous oxide accumulation in the presence of acetylene (acetylene blockage), was examined in short-term experiments with saltmarsh sediments. At concentrations of 1000 ppm (weight metal : weight dry sediment), HgCl2, PbC12, CdC12, ZnSO4, CuC12, K2Cr2O7, K2CrO4, and Na2MoO4 decreased acetylene reduction throughout the experiments by more than 30%. FeCl3 decreased it to a lesser extent, while NiC12 greatly stimulated nitrogenase activity. Initial rate of nitrous oxide production was inhibited by HgC12, PbC12, NiCl2, K2Cr2O7, K2CrO4, ZnSO4, CuCl2, FeCl3, and CdCl2, but maximum production was stimulated substantially by PbCl2, K2Cr2O7, and K2CrO4, and somewhat by Na2MoO4, ZnSO4, and CuCl2. In contrast, NiCl2 depressed both initial and maximum nitrous oxide production. Lower levels of Ni and Hg (10 and 100 ppm) caused effects that were intermediate between 1000 ppm and controls. Metal pollution could considerably alter nitrogen dynamics in marine sediments, at least in the short term; and could have repercussions on water-column productivity. (Author's abstract)
W85-02539

BEHAVIOR OF TRACE METALS IN MYTILUS EDULIS DURING A RECIPROCAL TRANSPLANT FIELD EXPERIMENT,
Battelle Pacific Northwest Labs., Sequim, WA. Marine Research Lab.
G. Roesijadi, J. S. Young, A. S. Drum, and J. M. Gurtisen.
Marine Ecology Progress Series, Vol. 18, No. 1-2, p 155-170, June, 1984. 12 Fig, 4 Tab, 36 Ref. NOAA grant NA81RAD00019.

Descriptors: *Mussels, *Trace metals, *Bioindicators, *Sequim Bay, *Tacoma, *Washington, Bioaccumulation, Copper, Zinc, Cadmium, Mercury, Silver, Heavy metals, Seawater, Water pollution effects.

Marine mussels Mytilus edulis were transplanted reciprocally from relatively pristine Sequim Bay to a metal-contaminated site at Tacoma (both Washington State) and vice versa. Temporal patterns of trace metal accumulation by the mussels, metal incorporation into subcellular compartments (low molecular weight, metal-binding proteins, lysosome-like vesicles) and condition index (a measure of animal health) were studied in a field experiment. Analysis of seawater from the Tacoma site showed elevated concentrations in all the metals examined in this study; i.e. copper, zinc, cadmium, mercury, and silver. Values fluctuated with time; peak concentrations were 105 ppb copper, 113 ppb zinc, 5.4 ppb cadmium, 0.0189 ppb mercury, and 0.13 ppb silver. These values were 255x, 188x, 103x, 47x and 138x the respective metal concentrations in Sequim Bay. With the exception of cadmium, the tissues of indigenous mussels at the Tacoma site reflected the high seawater metal concentrations. Mussels transferred from Sequim to Tacoma accumulated metals rapidly and approached or exceeded the metal concentrations in Tacoma mussels. General patterns were complicated by fluctuations in metal concentrations. Loss of metals following reciprocal transfer was relatively rapid in copper and silver values which were close to background levels after 4 wk and slower with zinc and mercury (24 wk or longer to background). Patterns of accumulation and loss and organs for concentration were specific for individual metals. Gills and digestive gland, for example, varied in their abilities to concentrate different metals and were often more sensitive indicators of metal bioconcentration than the whole organism. Gills were also examined for copper, cadmium and zinc on low-molecular-weight metal-binding proteins, high-molecular-weight proteins (< 70,000 Mr), and pelleted fraction. A highly significant correlation ($r = 0.87$, $p < 0.01$) existed between copper in whole tissues and copper associated with the 3 fractions identified above. Changes in copper in the subcellular compartments paralleled changes in the whole tissues in this study. X-ray microanalysis provided evidence for the localization of zinc as being primarily in the kidneys and was useful for examining the metal composition of organs which could not be easily excised and analyzed using other procedures. Measurement of condition index indicated that Tacoma mussels were stressed by the field conditions; condition index was reduced in both transplanted and indigenous groups of mussels at Tacoma. The time at which the reduction was sustained over time coincided with the time at which the trace metals in Tacoma seawater had risen to extremely high concentrations. (Author's abstract)
W85-02540

BENTHOS OF A COASTAL POWER STATION THERMAL DISCHARGE CANAL,
Central Electricity Generating Board, Fawley (England). Marine Biological Unit.
R. N. Bamber, and J. F. Spencer.
Journal of the Marine Biological Association of the U.K., Vol. 64, No. 3, p 603-623, August, 1984. 11 Fig, 3 Tab, 39 Ref, 2 Append.

Descriptors: *Thermal pollution, *Kingsnorth Power Station, *River Medway, *Kent, *England, *Benthos, *Ecological effects, Temperature effects, Salinity, Water temperature, Sediment, Thermal stress, Water pollution effects, Population density, Estuarine environment.

Kingsnorth Power Station, on the River Medway Estuary, Kent, discharges cooling water into a canal comprising a 4 km creek system. A comprehensive investigation of the sublittoral benthic fauna of the discharge system was undertaken from January 1979 to September 1981. The benthic macrofauna was sampled monthly at five stations along the system and a sixth in the River Medway adjacent to the creek mouth (DC4); salinity, seabed temperature, sediment particle size, sediment redox potential, residual chlorine and meiofaunal numbers were measured. The macrofauna is significantly suppressed at sites along the discharge canal, representing a community with half the number of species as at station DC4, comprising dense populations of a few dominant opportunistic species tolerant of thermal stress (e.g. Tubificoides, Cauleriella), and not those characteristic of organic pollution stress communities. The latter are regular summer immigrants in the creek, but persist only in low numbers if at all in the winter (e.g. Polydora ciliata). This suppression is the result of an approximately 10 degrees C temperature front between the heated discharge water and ambient estuarine water, passing over the sea bed with the ebbing and flooding tide four times each day. The residual gradient of mean temperature along the discharge canal causes some changes in the dominance of those species not eliminated by the temperature front. These temperature effects are expected to be

localized, mainly in the area of sea-bed impingement of the discharge water; they are predicted to occur at any thermal discharge in tidal waters where the heated effluent contacts the sea bed. (Author's abstract)
W85-02542

ULTRASTRUCTURAL LOCALIZATION OF METALS IN SPECIMENS OF LITTORINA LITTOREA COLLECTED FROM CLEAN AND POLLUTED SITES,
Reading Univ. (England). Dept. of Zoology.
A. Z. Mason, K. Simkiss, and K. P. Ryan.
Journal of the Marine Biological Association of the U.K., Vol. 64, No. 3, p 699-720, August, 1984. 6 Fig, 2 Tab, 34 Ref. Natural Environment Research Council grant GR3/3063A.

Descriptors: *Periwinkle, *Metals, *Biochemical pathways, *Path of pollutants, Benthos, Toxicology, Gastropods, Menai Straight, Wales, Restronguet Creek, Fal Estuary, Cornwall, England.

Specimens of the periwinkle, Littorina littorea (L.), were collected from a relatively unpolluted site on the Menai Straight, N. Wales, or from the heavily polluted site at Restronguet Creek on the Fal Estuary, Cornwall. The ultrastructural organization of various metal-containing cells of the specimens were analyzed to provide information on the specificity and identity of the biochemical pathways involved in manipulating the metals. These cells occur in the connective tissue, digestive gland, kidney, stomach and ctenidia. The majority of the metals were bound to intracellular ligands. The diversity of ligands includes differences in both composition of the ligands and their availability to pollutant metals. The ligands are usually compartmentalized within membrane-delineated structures. The basophil cells and connective tissue calcium cells appear to contain oxygen donor ligands which mainly bind class A metals (e.g. Ca, Mg, K, Mn). The pore cells and ctenidium contain sulphur donor ligands which mainly bind copper. Ligands of unknown composition occur in the nephrocytes and stomach epithelial cells. The ligands in the basophil cells and the nephrocytes appear to bind a wide range of metals and may therefore serve a detoxification function. Ligands in the connective tissue calcium cells and pore cells are very specific in their binding characteristics, and this presumably reflects some particular metabolic pathway within these cells. Ligands associated with the stomach and ctenidial epithelia appear to be responsible for preventing the penetration of metals through these layers. The effects of ligand specificity, induction and turnover rates will lead to variation in the results obtained in the use of an organism such as L. littorea as a monitoring system for metal pollution. (Collier-IVI)
W85-02543

PHYTOPLANKTON DISTRIBUTION IN THE COASTAL AREA SUBJECT TO THE IMPACT WITH THE TIBER RIVER OUTFALL,
Istituto di Ricerca sulle Acque, Rome (Italy).
A. Puddu, and R. Arfi.
Internationale Revue der Gesamten Hydrobiologie, Vol. 69, No. 4, p 541-552, 1984. 4 Fig, 3 Tab, 36 Ref.

Descriptors: *Phytoplankton, *Coastal areas, *Tiber River, *Italy, *Water pollution effects, Marine enviroments, Spatial distribution, Diatoms, Nutrients.

The Tiber, which is the second-ranking river in Italy in terms of flow and basin area, carries a substantial pollutant load at its outfall. Municipal effluents from Rome are chiefly responsible for this situation. Due to its river plume effects, estuary-like conditiitions exist at the Tiber outfall. The taxonomic composition and geographical distribution of phytoplankton in the coastal zone surrounding the River Tiber mouth were investigated in twelve surveys from April 1978 to September 1979. Ninety phytoplankton species were identified from 168 samples. Populations were dominated by diatoms, which accounted for more than 95% of total phytoplankton. Among these, small sized and strongly euryhaline organisms like Rhizosolenia delicatula, R. fragilissima and Leptocylindrus danicus were the dominant species throughout the observation period. The direct impact on the coastal environment of Tiber River water and its considerable nutrient load were seen as providing a permanent potential for the development of less structured phytoplankton communities within which there is a prevalence of clearly opportunistic members. Heterogeneity of local hydrological conditions and fluctuations in the river's impact, lead to a virtually constant instability in the neritic environment near the Tiber River outfall. (Moore-IVI)
W85-02569

MUTAGENIC ACTIVITY OF RUNOFF AND LEACHATE WATER FROM HAZARDOUS WASTE LAND TREATMENT,
Texas A and M Univ., College Station. Dept. of Soil and Crop Sciences.
For primary bibliographic entry see Field 5B.
W85-02588

IMMUNE RESPONSE IN RAINBOW TROUT SALMO GAIRDNERI AFTER LONG-TERM TREATMENT WITH LOW LEVELS OF CR, CD AND CU,
Milan Univ. (Italy). Sezione di Ecologia.
G. Viale, and D. Calamari.
Environmental Pollution (Series A), Vol. 35, No. 3, p 247-257, 1984. 1 Fig, 3 Tab, 25 Ref.

Descriptors: *Trout, *Immunity, *Chromium, *Cadmium, *Copper, Water quality standards, Heavy metals, Toxicity.

Metals have been demonstrated to affect the immune system of mammals and fish. The immune response was studied in rainbow trout Salmo gairdneri in order to validate the proposed water quality criteria for chromium, cadmium and copper. The kinetics of antibody production against human red blood cells were followed during a 4-month experiment in fish exposed to 50 and 200 micro g Cr/liter, 1.0 and 10 micro g Cd/liter and 30 and 100 micro g Cu/liter. Cadmium slightly reduced the humoral immune response at both concentrations tested while chromium and copper were ineffective. These findings are discussed in the framework of the validation of the proposed water quality criteria for chromium, cadmium and copper. (Author's abstract)
W85-02589

WASTEWATER TREATMENT WITH AQUATIC PLANTS: ECOTYPIC DIFFERENTIATION OF TYPHA DOMINGENSIS SEEDLINGS,
Commonwealth Scientific and Industrial Research Organization, Griffith (Australia). Centre for Irrigation Research.
For primary bibliographic entry see Field 5D.
W85-02590

ACIDIFICATION OF WATER AND EXTRAHEPATIC BIOTRANSFORMATION IN FISH,
Kuopio Univ. (Finland). Dept. of Physiology.
M. Laitinen, E. Hietanen, M. Nieminen, and P. Pasanen.
Environmental Pollution (Series A), Vol. 35, No. 3, p 271-278, 1984. 6 Fig, 19 Ref.

Descriptors: *Fish, *Enzymes, *Acidification, *Biotransformation, Hydrogen ion concentration, Whitefish, Kidney, Duodenum, Metabolism.

Biotransformation reactions catalyze the metabolism of foreign compounds, as well as that of endogenous substrates, for instance, the hormones. If the capacity of biotransformation reactions is modified, the whole physiology of the fish will change. The effects of decreased aquatic pH on the extrahepatic biotransformation reactions were studied in whitefish (Coregonus peled). The tissues studied were the kidney and duodenal mucosa, which are known to have biotransformation activity. Fish were exposed to water of pH 3 for 8 h and extrahepatic biotransformation was monitored by measuring renal and duodenal activities of ethoxycoumarin O-deethylase, epoxide hydrase, aryl hydrocarbon hydroxylase and UDP-glucuronosyltransferase at 18 C and 25 C. In the kidney the activities of ethoxycoumarin O-deethylase and epoxide hydrase were increased with acidic water while the opposite was true with aryl hydrocarbon hydroxylase. In acidic water ethoxycoumarin O-deethylase also showed a tendency to increase in duodenal mucosa. These results indicate that the renal and duodenal metabolism of foreign compounds is modified with acidification of water. (Moore-IVI)
W85-02591

EFFECTS OF CADMIUM ON AQUATIC HYPHOMYCETES,
Basel Univ. (Switzerland). Botanisches Inst.
T. H. Abel, and F. Barlocher.
Applied and Environmental Microbiology, Vol. 48, No. 2, p 245-251, August, 1984. 4 Fig, 4 Tab, 21 Ref.

Descriptors: *Cadmium, *Aquatic fungi, *Hardness, Water pollution effects, Sporulation, Plant growth, Calcium, Phytotoxicity.

The effects of cadmium on aquatic hyphomycetes were studied in stream waters of different chemical characteristics, and factors responsible for different sensitivities to cadmium were identified. Oak leaves were exposed in a hard-water stream and a soft-water stream for 2 months. In the laboratory, fungal sporulation on the leaves in stream water enriched with cadmium (as CdCl2) was studied. A measurable effect was found when the cadmium concentration exceeded 0.1 ppm (0.1 mg/liter). Concentrations higher than 100 ppm inhibited conidium production completely. This toxic effect of cadmium was species dependent and much higher in soft water than in hard water. Growth experiments with Alatospora acuminata, Clavariopsis aquatica, Flagellospora curvula, Heliscus lugdunensis, and Tetracladium marchalianum showed the same pattern of cadmium sensitivity as that seen in the sporulation experiments. Mycelial growth was less sensitive to cadmium than was fungal sporulation. High concentrations of competing cations (e.g., calcium and zinc) or potential ligands could reduce cadmium toxicity. The lower sensitivity of fungi sporulating in hard water was almost certainly due to its higher Ca content. Calcium ions presumably compete with Cd for binding sites at enzymes or other proteins. They may reduce the irreversible damage due to Cd-protein complexing. Although the content of organic ligands was higher in the soft-water fungi, concentrations were too low to have any effect at high Cd concentrations. (Moore-IVI)
W85-02592

EVIDENCE FOR THE ROLE OF COPPER IN THE INJURY PROCESS OF COLIFORM BACTERIA IN DRINKING WATER,
Montana State Univ., Bozeman. Dept. of Microbiology.
For primary bibliographic entry see Field 5F.
W85-02594

PHOSPHORUS RESIDENCE TIME IN RELATION TO TROPHIC CONDITIONS IN LAKES,
Canada Centre for Inland Waters, Burlington (Ontario).
For primary bibliographic entry see Field 2H.
W85-02616

IMPORTANCE OF INTERNAL PHOSPHORUS LOAD TO THE EUTROPHICATION OF LAKES WITH ANOXIC HYPOLIMNIA,
McGill Univ., Montreal (Quebec). Dept. of Biology.
G. Nurnberg, and R. H. Peters.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 1, p 190-194, July, 1984. 8 Fig, 9 Ref.

Descriptors: *Eutrophication, *Phosphorus, *Cycling nutrients, *Lakes, *Hypolimnion, Iron, Thermal stratification, Epilimnion, Anoxic conditions, Plankton.

Experimental studies and literature data were gathered on eight lakes in Canada with anoxic hypo-

limnia. The iron concentration in these waters ranged from 0 to 7 mg/l and the iron was almost completely in the ferrous state. Therefore oxygen was excluded during all sampling. Phosphorus appears to accumulate in anoxic hypolimnia of culturally eutrophied lakes at a mean rate of 12 to 16 mm/sq m/day as determined from core tubes containing sediment and water and in situ estimates. This release produces steep P gradients in the anoxic hypolimnia during stratified periods. The proportion of total hypolimnetic P which is potentially available provided it comes into contact with P deficient plankton, was determined as soluble reactive phosphorus to give a maximium estimate and by bioassays to give a more appropriate estimate. Results suggest that under optimal conditions epilimnetic plankton can use approximately 70% of entrained hypolimnetic total phosphorus when concentrations in the hypolimnion exceed 100 micro g/l total P. How much of hypolimnetic P actually contributes to eutrophication will depend on the capacity of the plankton to take up the hypolimnetic P after thermocline erosion. While this is difficult to assess, the study suggests that high internal P loads increase eutrophication in lakes. (Baker-IVI)
W85-02618

PHOSPHORUS RELEASE PATTERNS FROM SEDIMENTS OF A MEROMICTIC MESOTROPHIC LAKE (PIBURGER SEE, AUSTRIA),
Innsbruck Univ. (Austria). Dept. of Limnology.
R. Psenner.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 1, p 219-228, July 1984. 5 Fig, 35 Ref.

Descriptors: *Phosphorus, *Lake sediments, *Piburger See, *Austria, *Meromictic lakes, *Mesotrophic lakes, Trophic levels, Temperature effects, Eutrophication, Oxygen, Phosphates.

Piburger See is a mesotrophic softwater lake with an area of 13.4 ha and a maximum depth of 24.6 m. The lake is situated in the Eastern Alps near Oetz, Austria. The catchment area is formed by siliceous rocks; 75% of the lake bottom consists of soft, noncalcareous organic rich sediment. Piburger See is meromictic and has suffered from cultural eutrophication since the early sixties. This study has revealed that different release patterns for phosphorus occur within the same lake at different depths depending on temperature and oxygen supply, both of which were experimentally modified. Release rates measured in laboratory experiments with undisturbed sediment cores proved well coordinated with the interstitial water concentration of soluble reactive phosphorus and/or the concentration gradient across the interface. The diffusion controlled phosphate flux accounted only for 1/10 to 1/50 of the release rate determined in lab studies. Beside the effect of iron bound and apatite phosphorus, the NaOH-P fraction is the most important for the release and uptake mechanisms. NaOH-P constitutes a phosphorus reservoir capable of rapid interactions with the dissolved phosphate pool over the whole range of lake depth, independently of redox conditions. (Baker-IVI)
W85-02619

NITROGEN LOADING: INFLUENCE ON DISSOLVED INORGANIC CARBON IN NATURAL WATERS,
Hidrobioloski Zavod, Ochrida (Yugoslavia).
T. Naumoski, and J. T. Lehman.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 1, p 244-249, July, 1984. 3 Fig, 1 Tab, 18 Ref.

Descriptors: *Lakes, *Nitrogen, *Acid rain, *Third Sister Lake, *Michigan, Nitrates, Chemical reactions, Algae, Inorganic carbon, Natural waters, Kettle lakes, Phytoplankton.

Experiments were conducted in Third Sister Lake, a 16 m deep kettle lake in southern Michigan 5 km west of Ann Arbor. Enclosures of clear plastic were filled with water from 3 m and were enriched with nutrients while being filled. Treatments consisted of sodium phosphate with ferric chloride and sodium nitrate, nitric acid, or ammonium chloride to replicate enclosures. Given equimolar additions of ammonia or nitrate, the ammonia is more swiftly converted to new phytoplankton biomass measured as chlorophyll. There was some indication that alkalinity changes occur accompanying phosphate uptake. The relevance of the study to the global problem of acid rain is noted. Because uptake of nitrate by phytoplankton causes an increase in alkalinity, all of the strong acid added to two of the enclosures as nitric acid would have been neutralized if the algae removed all the nitrate. In lakes were nitrate loading derives from acid rain the processes described here lead to biological neutralization of some of the acid and to diminution of its effects. (Baker-IVI)
W85-02623

MODELING CHEMICAL WATER QUALITY IN RESERVOIRS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
M. J. Zimmerman.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 1, p 254-260, July, 1984. 2 Fig, 14 Ref.

Descriptors: *Water quality control, *Reservoirs, *Model studies, *Eutrophication, Water quality management, Chlorophyll a, Simulation, Hydrodynamics.

Various water quality modeling approaches are discussed as they pertain to reservoirs. The insensitivity of these models to data variability as well as to violations of their own assumptions are emphasized. Within the context of their intended purposes and constraints, all the techniques seem capable of producing reasonably good characterizations or simulations of the systems considered. Loading and empirical regression models yield good predictions of chlorophyll a concentrations which may indicate the necessity of controlling nutrient inputs. Equilibrium calculations provide detailed descriptions of biogeochemical events associated with eutrophication and, thus, can aid in assessing some of the more diverse ramifications of water quality management. Ecosystem level models are particularly valuable for their ability to simulate operational conditions of reservoirs. They account for time-dependent behavior and the effects of hydrodynamics on physical, chemical, and biological aspects of water quality. At the coarsest level of resolution lie the loading and regression models. Next are the one-dimensional ecosystem compartment models which incorporate up to date hydrodynamic simulation capability. At the finest level are chemical equilibrium calculations which can provide highly detailed descriptions of system chemistry. No one modeling approach is best for all possible applications. (Baker-IVI)
W85-02624

SUMMARY OF US OECD EUTROPHICATION STUDY. RESULTS AND THEIR APPLICATION TO WATER QUALITY MANAGEMENT,
Texas Tech Univ., Lubbock. Dept. of Civil Engineering.
G. F. Lee, and R. A. Jones.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 1, p 261-267. July, 1984. 2 Fig, 12 Ref.

Descriptors: *Water quality control, *Eutrophication, *Water quality management, Nutrients, Phosphorus, Organic compounds, Fertilizers, Reservoirs, Dissolved oxygen.

A Cooperative Program on Eutrophication was initiated in the early 1970's under the auspices of the Organization for Economic Cooperation and Development (OECD). The program was to quantify relationships between nutrient loads to water bodies and their eutrophication related water quality responses. The project included a five year study of about 200 lakes and impoundments in Australia, Japan and 16 countries in Western Europe and North America. The results of the study conducted in the United States are reported. The primary factor that motivated the initiation of the study was the development of a management tool that could be widely used to predict the impact of altering P loads to waterbodies on the waterbodies' eutrophication-related water quality. Specific problems of concern range from domestic water supply water quality, low dissolved oxygen below hydropower releases from reservoirs, agricultural irrigation water quality, and impaired recreational use of waterbodies. The modeling approach is a powerful tool for eutrophication-related water quality evaluation/management. (Baker-IVI)
W85-02625

EMPIRICAL MODELS FOR PREDICTION OF ALGAL BLOOMS AND COLLAPSES, WINTER OXYGEN DEPLETION AND A FREEZE-OUT EFFECT IN LAKES: SUMMARY AND VERIFICATION,
Canada Centre for Inland Waters, Burlington (Ontario).
For primary bibliographic entry see Field 2H.
W85-02631

EFFECTS OF PHOSPHORUS FERTILIZATION ON PHYTOPLANKTON BIOMASS AND PHOSPHORUS RETENTION IN SUBARCTIC QUEBEC LAKES,
McGill Univ., Montreal (Quebec). Dept. of Biology.
For primary bibliographic entry see Field 2H.
W85-02635

EFFECTS OF AN IN SITU ARTIFICIAL ACIDIFICATION ON THE LACUSTRINE PHYTOPLANKTON AND ZOOPLANKTON (EFFETS D'UNE ACIDIFICATION ARTIFICIELLE IN SITU SUR LE PHYTOPLANCTON ET LE ZOOPLANCTON LACUSTRE),
Ecole Polytechnique, Montreal (Quebec). Section du Genie de l'Environnement.
C. E. Delisle, L. Roy, P. Bilodeau, and P. Andre.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 383-387, July, 1984. 2 Fig, 10 Ref.

Descriptors: *Acidification, *Phytoplankton, *Zooplankton, *Lake Kempt, *Quebec, Lakes, Heavy metals, Acid rain, Water pollution effects, Hydrogen ion concentration, Species composition, Biomass, Primary productivity.

Because of interest in the effects of acid rain on planktonic communities, artificial acidification experiments were carried out in enclosures in Lake Kempt. Lake Kempt is located about 200 km north of Montreal. It is free of local sources of pollution, but is in a zone considered to be very sensitive to acidification, in part because of its location downwind of industrial centers, and in part because the geological formation is dominated by gneiss granite. The transparent plastic enclosures are 2 m in diameter and in depth. The pH in the enclosures was modified to 4.0, 5.0, and 5.5 by the addition of sulfuric acid. The liberation of heavy metals from sediments was affected by acidification. Zooplankton communities were affected by the acidification: dominance of Bosmina and a reduction in the number of species are characteristic of acid environments. The number of phytoplankton taxa is reduced: between 30 and 50 taxa were found in the control enclosures; only 20 were found at pH 4.0. Biomass, measured as chlorophyll a, did not vary significantly. At pH 4.0, there is a clear increase in productivity. (Moore-IVI)
W85-02636

PLANKTON OF AN ACID-STRESSED LAKE (KEJIMKUJIK NATIONAL PARK, NOVA SCOTIA, CANADA); PART 1, DESIGN AND WATER CHEMISTRY RESULTS OF AN ENCLOSURE EXPERIMENT,
Dalhousie Univ., Halifax (Nova Scotia). Dept. of Biology.
For primary bibliographic entry see Field 2H.
W85-02637

GROWTH RESPONSES OF RIVER AND LAKE PHYTOPLANKTON POPULATIONS IN LAKE MICHIGAN WATER,
Michigan Univ., Ann Arbor. Great Lakes Research Div.

For primary bibliographic entry see Field 2H.
W85-02638

LONG-TERM PHYTOPLANKTON CHANGES IN LAKE MICHIGAN: CULTURAL EUTROPHICATION OR BIOTIC SHIFTS,
Wisconsin Univ.-Milwaukee. Center for Great Lakes Studies.
For primary bibliographic entry see Field 2H.
W85-02639

BENTHIC AND EPIBENTHIC (MICROCRUSTACEANS, MACROBENTHOS) COMMUNITY STRUCTURE IN THE VICINITY OF A POWER PLANT, SOUTHEASTERN LAKE MICHIGAN,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
M. S. Evans.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 1, p 488-494, July 1984. 3 Fig, 2 Tab, 8 Ref.

Descriptors: *Powerplants, *Thermal pollution, *Lake Michigan, *Benthos, *Epibenthos, Nuclear powerplants, Heated water, Effluents.

The effects of operating the Donald C. Cook Nuclear Plant on epibenthic and benthic communities in the adjacent aquatic communities were investigated. Twenty-six sampling stations were investigated. A moderate effect was noted on epibenthic and benthic communities. Macrobenthic taxa abundances were only slightly different (amphipods, chironomids) or the same (oligochaetes) in plume or control regions. The affected area was relatively small and located within a few hundred meters of the intake and discharge structures. Condenser passed water is discharged at a high velocity through subsurface discharge jets resulting in a rapid loss of temperature and the formation of a floating plume. It is probably only within a few tens of meters of the discharge jets where plume temperatures are more than 2 C above ambient and where the sediment is scoured by the high current velocities that epibenthic and benthic community structure is strongly altered by plant operation. (Baker-IVI)
W85-02641

MT. ST. HELENS ASH IN LAKES IN THE LOWER GRAND COULEE, WASHINGTON STATE,
Washington Univ., Seattle. Dept. of Zoology.
W. T. Edmondson, and A. H. Litt.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 1, p 510-512, July, 1984. 1 Fig, 10 Ref.

Descriptors: *Volcanic ash, *Aquatic life, *Mt. St. Helens, *Soap Lake, *Lake Lenore, *Washington, Midges, Benthos, Amphipods, Daphnia, Crustaceans, Alkaline lakes, Volcanoes.

The eruption of Mt. St. Helens in May of 1980 caused the deposit of volcanic ash into two alkaline lakes in central Washington state, Soap Lake and Lake Lenore, which had been a part of an ongoing study of flora and fauna and high productivity conditions. Following the eruption, the adundance of Diaptomus sicilis decreased sharply in both lakes, but this was also the time seasonally for this to occur. Also, after the ashfall, Moina hutchinsoni in Soap Lake and Daphnia pulex in Lake Lenore went through their seasonal increase. An unusual number of dead amphipods were seen in Lake Lenore but the population did increase during the summer. Salamander tracks were visible on the ash layer and chironomid larvae were able to burrow up through the ash layer and reestablish their tubes. (Baker-IVI)
W85-02643

CRATER LAKE STUDY: DETECTION OF POSSIBLE OPTICAL DETERIORATION OF A RARE, UNUSUALLY DEEP CALDERA LAKE IN OREGON, U.S.A.,
Army Engineer District, Portland, OR.
For primary bibliographic entry see Field 2H.
W85-02644

LAKE ACIDIFICATION AND THE BIOLOGY OF ADIRONDACK LAKES: I. ROTIFER COMMUNITIES,
New York State Museum, Albany. Science Service Div.
C. A. Siegfried, J. W. Sutherland, S. O. Quinn, and J. A. Bloomfield.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 1, p 549-558, July, 1984. 8 Fig, 1 Tab, 11 Ref.

Descriptors: *Mountain lakes, *Adirondack Mountains, *Acidification, *Rotifers, Water pollution effects, Aquatic animals, Acid lakes, Hydrogen ion concentration.

The lakes selected for study were all within the Adirondack Park. More than 50 rotifer species were identified from these lakes. The number of rotifer species present generally declined with decreasing pH levels. Waters with pH less than 5.0 generally had fewer than 8 rotifer species while waters with pH values greater than 6.0 generally had more than 10 species. The greatest number of species identified from any one lake was 18 from circumneutral Elk Lake. Two acid lakes, Goose Lake and Jones Lake contained only 2 species of rotifer. The differences in the structure of Adirondack rotifer communities in relation to pH may represent only an indirect relationship to pH. As pH decreases many other chemical changes also occur, such as mobilization of heavy metals, which may impact the rotifer community. Changes in other communities such as phytoplankton, crustacean zooplankton, or fish directly or indirectly related to pH may have significant impacts on the rotifer community. (Baker-IVI)
W85-02646

RECENT PH HISTORY OF BIG MOOSE LAKE (ADIRONDACK MOUNTAINS, NEW YORK, U.S.A.) INFERRED FROM SEDIMENT DIATOM ASSEMBLAGES,
Indiana Univ. at Bloomington. Dept. of Biology.
D. F. Charles.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 1, p 559-566, July, 1984. 4 Fig, 27 Ref.

Descriptors: *Mountains lakes, *Acidity, *Big Moose Lake, *New York, Adirondack Mountains, *Diatoms, Aquatic life, History, Hydrogen ion concentration, Acid deposition, Water pollution effects.

Attempts were made to reconstruct the pH history of an acidic Adirondack lake by analyzing changes in diatom assemblages and to determine probable causes for the changes which have occurred. Big Moose Lake is located in the southwestern Adirondacks at an elevation of 556 m. It has a surface area of 515 ha, a watershed area of 8760 ha, and maximum depth of 2 m. From about 1800 until about 1950 the inferred pH of the lake was about 5.7. Diatom assemblages were dominated by the euplanktonic taxon Cyclotella stelligera. After 1950 the inferred pH decreased steadily and relatively quickly to about 4.7. Measured pH has been at about this value for at least the last 10 yr. Measurements of air-equilibrated surface pH of the lake have typically ranged from 4.6 to 5.0 during the past eight years. Stauroneis gracillima and Fragilaria cf. virescens var 1 dominate the surface sediment assemblages. The decrease in inferred pH is corroborated by historical water chemistry data and by an assessment of the decline and disappearance of fish populations. The most reasonable explanation for the cause of the decline of inferred pH is strong acid deposition. This is indicated primarily by the rate and magnitude of the pH change. (Baker-IVI)
W85-02647

HETEROTROPHIC BACTERIAL COMMUNITY IN OLIGOTROPHIC LAKE TAHOE,
Tokyo Metropolitan Univ. (Japan). Dept. of Biology.
For primary bibliographic entry see Field 2H.
W85-02649

LITTORAL PHYTOPLANKTON PRODUCTIVITY AND BIOMASS AS INDICATORS OF DIFFERENTIAL NUTRIENT LOADING OF LAKE TAHOE,
California Univ., Davis. Inst. of Ecology.
S. L. Loeb, P. Eloranta, and J. E. Reuter.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 1, p 605-611, July, 1984. 3 Fig, 4 Tab, 21 Ref. California State Water Resources Control Board grant 0-136-160.

Descriptors: *Primary productivity, *Lake Tahoe, *Phytoplankton, *Biomass, Nutrients, Bioindicators, Algae, Littoral zone, Snowmelt.

The annual pattern of Lake Tahoe's littoral phytoplankton productivity exhibited a rather large range for waters representing the most superficial waters of the euphotic zone. Maxmimum water column productivity during 1981 usually occurred between 20-40 m and rarely exceeded 1.00 mg C/cu m/hr. Phytoplankton productivity at three shallow littoral stations was greater than phytoplankton productivity measured in the shallow pelagial waters. The April through June periods of highest littoral phytoplankton productivity and greatest littoral-pelagial productivity differential were also coincident with the time period when over 50% of the total annual stream runoff entered Lake Tahoe from the melting snow pack. These findings suggest that materials entering the lake from the surrounding watershed exert their initial and possibly greatest biostimulatory effects on the littoral waters. No significant correlations were found between the size of the nutrient pools and littoral phytoplankton productivity or biomass. Station-to-station differences in water chemistry showed no discernible patterns. Ammonium-nitrogen and soluble phosphorus were below the levels of detection. The utility of the littoral phytoplankton community as a site-specific method to evaluate nutrient pollution sources was demonstrated with some success. (Baker-IVI)
W85-02651

VARIABILITY IN PHOSPHORUS CONCENTRATIONS IN NORTH TEMPERATE LAKES: A CASE STUDY OF ANTHROPOGENIC FORCING,
Salford Univ. (England). Dept. of Civil Engineering.
P. B. R. Archer, and B. Henderson-Sellers.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 1, p 633-637, July, 1984. 2 Fig, 20 Ref.

Descriptors: *Phosphorus, *Lakes, *Recreation wastes, *Windermere Lake, *England, Water quality, Nutrient cycling, Water pollution effects, Boating.

The overall productivity of a lake or reservoir has been evaluated traditionally in terms of its trophic state. There is no widely accepted quantitative scheme for undertaking such an assessment and furthermore such values indicate trends over years and give no information on time scales less than a year. The incorporation of nutrient concentrations into multi-box or multi-layer one-dimensional thermal stratification models is currently being tested. Many details of the inlake phosphorus cycling are not yet fully evaluated. Some of these mechanisms are reported. In this study of a mesotrophic north temperate lake, Lake Windermere, a temporal scale of 1 week is used in evaluating P variability at 5 sampling stations in the North basin of the lake. Windermere is subject to surges of intense tourist pressure on national holiday weekends. At these times the human population of 10,000 trebles, resulting in increased P concentrations in the lake. The incidence of this additional forcing factor on P concentrations, together with other, such as powerboating, leads to the recognition of a need for properly documented data bases to be made available to mathematical modellers of water quality. (Baker-IVI)
W85-02652

EFFECTS OF ROTENONE TREATMENT ON THE BENTHIC FAUNA OF A SMALL EUTROPHIC LAKE,

Trondheim Univ. (Norway).
J. I. Koksvik, and K. Aagaard.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 1, p 658-665, July, 1984. 9 Fig, 15 Ref.

Descriptors: *Rotenone, *Fish control agents, *Benthic fauna, *Haugatjern, *Norway, Eutrophic lakes, Toxicity, Midges, Predation, Dissolved oxygen, Competition.

Knowledge was sought on the toxicity of rotenone on benthos when used in a concentration commonly recommended in Norway for the extermination of fish. The development of the bottom fauna when no longer influenced by fish predation was also considered. Haugatjern is a eutrophic lake situated in Central Norway at an elevation of 697 m with a surface area of 9.1 ha, maximum depth of 15.5 m, and mean depth of 7.6 m. On September 22, 1980, 350 liters of rotenone were pumped into the surface layers which equals a concentration of roughly 0.5 ppm. The lake was kept empty of fish until 1982 when it was stocked with 4000 fry of charr. The different taxa of Chironomidae must have a widely different tolerance to rotenone. Procladius seemed rather unaffected by the treatment and most possibly gained due to the decreased fish population. Chironomus appeared at first to be equally unaffected, but by the following year the genus was nearly completely missing until October. Tanytarsini species managed to colonize the 7 m depth with a density of more than 3,000 ind/sq m by July of 1982 while no Tanytarsini at all occurred at such a depth in 1980. Except for the genus Chironomus the rotenone treatment had no toxic effect on the investigated bottom fauna. The most important factor for the development after treatment seemed to be ceased predation by fish, altered interspecific competition and better oxygen conditions. (Baker-IVI)
W85-02653

5D. Waste Treatment Processes

REDUCTION IN TOXICITY OF ORGANIC PRIORITY POLLUTANTS BY PILOT-SCALE CONVENTIONAL WASTEWATER TREATMENT PROCESS,
Environmental Monitoring and Support Lab.-Cincinnati, OH.
W. B. Horning, II, E. L. Robinson, and A. C. Petrasek, Jr.
Archives of Environmental Contamination and Toxicology, Vol. 13, No. 2, p 191-196, March, 1984. 1 Fig, 3 Tab, 7 Ref.

Descriptors: *Wastewater treatment, *Priority pollutants, *Toxicity, Minnows, Daphnia, Trout, Activated sludge process, Effluents, Water quality.

Static acute toxicity tests with fathead minnows, Daphnia magna, and rainbow trout were used to demonstrate the effectiveness of a pilot-scale conventional wastewater treatment system in detoxifying a raw municipal wastewater that continuously received a mixture of 22 organic priority pollutants. Wastewater from the City of Cincinnati (Ohio) was added to two parallel pilot-scale (control and experimental) conventional activated-sludge wastewater treatment systems. The effect of chlorination on the acute toxicity of effluent from the experimental system was also investigated. The system typically reduced the organic priority pollutants by 89 to > 99%, and both systems provided excellent treatment of conventional pollutants. Even though toxicity reduction as high as 90% was achieved, significant toxicity was present in the experimental effluent. The study clearly supports the premise that organism responses should be considered, in addition to chemical and conventional pollutant characterization, to determine the quality of a wastewater discharge. (Author's abstract)
W85-02201

FACTORS AFFECTING THE REMOVAL OF METALS DURING ACTIVATED SLUDGE WASTEWATER TREATMENT; I. THE ROLE OF SOLUBLE LIGANDS,
Imperial Coll. of Science and Technology, London (England). Public Health Engineering Lab.
P. S. Lawson, R. M. Sterritt, and J. N. Lester.
Archives of Environmental Contamination and Toxicology, Vol. 13, No. 4, p 383-390, July, 1984. 7 Fig, 5 Tab, 33 Ref.

Descriptors: *Activated sludge process, *Metal removal, *Ligands, Wastewater treatment, Biomass, Sludge age, Chelation.

Samples of mixed liquor were withdrawn from a laboratory-scale activated sludge simulation operated at a range of sludge ages from 3 to 12 days in order to examine the difference in metal uptake by the mixed liquor biomass in the absence and presence of soluble ligands. One half of the samples were centrifuged, washed, and resuspended in physiological saline solution, and the rest were left unchanged. In another experiment, aliquots of synthetic sewage were added to mixed liquor samples to investigate the effect of increased soluble influent sewage ligands on metal uptake. It was found that at low sludge ages, uptake of metals by biomass was lower in the presence of soluble ligands than in their absence, but as the sludge age increased uptake in the presence of soluble ligands also increased. It is suggested that at low sludge ages, ligands predominantly prevented metal uptake by the biomass by chelating the metals and stabilizing them in solution and, at longer sludge areas, ligands predominantly enhanced uptake. Increasing the concentration of synthetic sewage caused a reduction in metal removal and it is suggested that soluble ligands in the synthetic sewage were responsible for preventing metal uptake. (Author's abstract)
W85-02209

FACTORS AFFECTING THE REMOVAL OF METALS DURING ACTIVATED SLUDGE WASTEWATER TREATMENT; II. THE ROLE OF MIXED LIQUOR BIOMASS,
Imperial Coll. of Science and Technology, London (England). Public Health Engineering Lab.
P. S. Lawson, R. M. Sterritt, and J. N. Lester.
Archives of Environmental Contamination and Toxicology, Vol. 13, No. 4, p 391-402, July, 1984. 13 Fig, 6 Tab, 34 Ref.

Descriptors: *Activated sludge process, *Metal removal, Biomass, Wastewater treatment, Copper, Nickel, Manganese, Cadmium, Cobalt, Thallium, Heavy metals, Mixed liquor.

Samples of mixed liquor from a laboratory-scale activated sludge simulation, operated at a range of sludge ages from 3 to 12 days, were treated with formaldehyde in order to obtain a metabolically inactive biomass. The metal removal behavior of this biomass was compared with that of untreated biomass. Only Cu and Ni were found to exhibit a high degree of removal in the presence of active biomass. Manganese, Cd, Co, and Tl demonstrated removals little affected by the activity of the biomass, and at longer sludge ages more metal was taken up by formaldehyde-treated than by untreated cells. Dispersed mixed liquor in the form of a bulking sludge was found to have a greater affinity for most metals than a well-settled, compact mixed liquor. Consequently, it is proposed that the important factors in metal removal by the mixed liquor solids were related to their behavior as particulates, the physical characteristics of the particle being more important than their viability. (Author's abstract)
W85-02210

CO^{D}A II AND THE RIVER MERSEY - A REGIONAL WATER AUTHORITY VIEW,
North West Water Authority, Warrington (England).
E. Harper.
Chemistry and Industry, No. 14, p 502-505, July, 1984. 5 Fig.

Descriptors: *Estuaries, *Water pollution control, *River Mersey Estuary, *England, *Planning, Water management, Industrial wastes, Wastewater treatment, Municipal wastes.

The River Mersey Estuary is the only exception to the exemption order under the Control of Pollution Acta (COPA) II on an area basis rather than a category basis. Reasons for this exception are presented from the point of view of North West Water, and guidelines for pollution control on this Estuary and their relevance to COPA II are discussed, considering particularly the vital role industry must play in this area. The whole Mersey catchment draining to the freshwater river and to a tidal river is highly urbanized and industrialized. The rivers in the Mersey catchment contain 16% of the Class 3 rivers and 24% of the Class 4 polluted rivers in the United Kingdom while being only 4% of the total length. While the inland river remains badly polluted in national terms, it has shown massive improvement during the past two decades. Significantly less improvement has been noted in the Estuary. The estuary is unusual in having a seriously polluted freshwater inflow which, together with the tidal tributaries, makes a major contribution to the dissolved oxygen sag, particularly in the upper reaches. If there were no further pollution loads discharged to the estuary, it would recover rapidly. The North West Water Authority has set a minimum objective of restoring dissolved oxygen to the estuary at all times. The Authority plans to achieve the minimum objectives for the estuary by the mid 1990s. Significant expenditures on provision of sewers and sewage treatment works for the Estuary will be made by that time. North West Water formally adopted guidelines in 1978 for effluent control for new industry and expansion of existing industry on the Mersey Estuary. These are considered more appropriate than rigid rules, as each industrial case is treated as a special one. (Baker-IVI)
W85-02225

COPA II AND THE RIVER MERSEY - AN INDUSTRIAL VIEW,
Imperial Chemical Industries Ltd., Runcorn (England). Mond Div.
P. R. Edwards.
Chemistry and Industry, Vol. 14, p 506-508, July, 1984. 2 Ref.

Descriptors: *Estuaries, *River Mersey, *Mersey Estuary, *England, *Water pollution control, Industrial wastes, Municipal wastewater, Effluents, Dissolved oxygen.

The Mersey Estuary receives surface drainage, sewage and industrial waste flows from the catchments of the Mersey and Weaver. These discharges of partially treated or untreated effluent result in low levels or the absence of dissolved oxygen in the upper estuary, along with the presence of grossly objectionable solids in the lower estuary. Significant improvements made during the past 10 year period include a reduction of the total biochemical oxygen demand load to the estuary to a value 70% of that of its 1972 load. A significant part of the reduction is due to internal measures adopted by individual factories. The main impact of the Control of Pollution Act (COPA) II is seen as accelerating existing programs and giving more power to the NWWA to press for reductions in certain polluting effluents which would continue unabated without the legislation. An interim objective on the way to total control for the upper estuary is that the water should contain dissolved oxygen at all times to avoid odor nuisance (at least 10% DO). The long term objective for tidal waters is 30% DO at all times. Despite general agreement that improvement of the Mersey is long overdue, there is concern over the cost implications of the proposed improvement program on industry via increased rates, increased effluent charges and the building of in-house treatment plants. Specific examples where the ICI has been and is continuing to spend money to improve its liquid effluent discharges in the Mersey catchment area include mercury removal from aqueous effluents, sewage diversions, changing technology at solvents plant, reductions of caustic discharges, use of new chloromethanes complex, and controlling ammonia discharges from ICI mid-Cheshire factories. (Baker-IVI)
W85-02226

IRON REMOVAL FROM TI02-PLANT ACIDIC WASTEWATER,
Murdoch Univ. (Western Australia). School of Environmental and Life Science.
G. E. Ho, P. J. Murphy, N. Platell, and J. E. Wajon.
Journal of Environmental Engineering, Vol. 110 No. 4, p 828-846, August, 1984. 13 Fig, 5 Tab, 8 Ref.

Descriptors: *Titanium dioxide plants, *Industrial wastewater, *Iron, *Wastewater treatment, Leschenault Peninsula, Australia, Ilmenite, Steel industry, Industrial plants, Sand dunes.

Wastewater from a titanium dioxide plant has been disposed via unlined spreading basins located in sand dunes at Leschenault Peninsula in Western Australia since 1968. Characteristics of the wastewater are typical of waste produced by a plant processing ilmenite to titanium dioxide using the sulfate process and are also similar to the characteristics of spent pickle liquor in the steel manufacturing industry. Besides neutralization of the acid, over 75% of the iron in the wastewater is removed by limestone in the dune sand. Calcium carbonate content of the sand varies from 1%-30% with an average concentration of about 15%. A pilot scale laboratory column experiment to investigate the interactions between the waste and the sand showed that the iron was removed from solution as iron carbonate just beyond the acid neutralization zone. The wastewater used in the investigation had concentrations of 101.9 g H2SO4/L and 160.6 g FeSO4/L. The iron is deposited in a narrow band which is moved along by the advancing acid front. Iron removal in the column averaged 78%, which is similar to removal observed in the field. Iron concentrations near 100 ppm were observed in both the column and the field. The precipitated iron in the form of calcium-iron carbonates is considered to be very insoluble in the dune environment based on the known chemistry of the carbonates. Iron removal can be maximized by providing for a contact time of at least 3 weeks between the waste and the sand. More rapid iron removal will occur with higher concentrations of iron in the wastewater, but the impact on acid neutralization efficiency is unknown. (Collier-IVI)
W85-02278

HYDROELECTRIC GENERATOR USED BY TREATMENT PLANT,
North Andover, MA.
E. Teittinen.
BioCycle, Vol. 25, No. 5, p 38, 40-41, July-August, 1984. 2 Fig, 1 Tab.

Descriptors: *Hydroelectric plants, *Wastewater facilities, Design criteria, Planning, Energy, Feasibility.

A wastewater treatment plant was designed to be located 60 feet above the Merrimack River to treat 52 million gallons/day. This location necessitated the construction of a $5.4 million pump station and an energy dissipating structure at the outfall. The energy dissipator extracted the fifty feet of available energy in the treated wastewater so it wouldn't scour the river bed when discharged. After the facility was in operation, a study determined the feasibility of using the energy for the generation of electricity. A hydroelectric generator was put on-line on the plant's outfall in 1983. Hydroelectric power generation at the wastewater treatment facility has helped offset the high cost of energy. The determination of the hydroelectric potential is fairly straight-forward using expertise that is not normally found in wastewater treatment and a consultant should be used. The economics are enhanced if hydro is considered during initial construction rather than retrofitting a turbine to an existing facility. (Baker-IVI)
W85-02301

SEWERMAN AND THE SCIENTIST; A PARABLE FOR THE ACADEMIC FOLLOWING A COURSE OF DECONTAMINATION (L'EGOUTIER ET LE SAVANT; CONTE MORAL POUR UNIVERSITAIRE EN CURE D'ASSAINISSEMENT),
Institut National Polytechnique, Toulouse (France).
C. Thirriot.
Houille Blanche, No. 1/2, p 27-64, 1984. 56 Fig, 51 Ref.

Descriptors: *Social aspects, *Wastewater disposal, *Sediment transport, *Flow, Decontamination, Wastewater treatment, Turbulence, Stochastic hydrology, Model studies, Mathematical models.

Socio-economic problems associated with decontamination are reviewed and their history of development is traced. Fundamental hydraulic aspects of drainage systems currently in operation are described. Aquatic life at the outlets of treated and untreated water outfalls is discussed including outfalls in rivers, lakes and seas. The effects of turbulence on energy dissipation, the transport of solids and the mixture of air with water are extensively examined. The stochastic approach to particulate transport in conduits and sedimentation tanks is explained. Problems encountered in mathematical models created to represent transient flow in pipelines are detailed. Several natural situations in lakes or gulfs are considered in depth with reference to the hydrological and hydrodynamic aspects. (Baker-IVI)
W85-02351

MUNICIPAL WASTEWATER TREATMENT AND ITS CONTROL IN FINLAND,
National Board of Waters, Helsinki (Finland).
M. Makela.
Aqua Fennica, Vol. 13, p 44-48, 1983. 5 Fig, 1 Tab.

Descriptors: *Finland, *Wastewater treatment, *Sewer systems, Biological wastewater treatment, Chemical treatment, Biochemical oxygen demand, Phosphorus removal, Ammonium nitrate, Effluents, Sewer infiltration.

Sewer systems designed to serve more than 200 inhabitants currently cover 71% of the population of Finland, or 3.4 million persons. Plants employing at least chemical or biological treatment account for 97% of these systems. Wastewater treatment today removes 80% of the total amount of BOD7 and phosphorus discharged from public sewers. About 79% of municipal wastewaters are treated biologically-chemically, 17% chemically and 1% biologically. The permitted maximum limits for the BOD7 value and phosphorus content in the effluent are normally 20 to 25 mg/l O2 and 0.5 to 1.5 mg/l P with a requirement of more than 80-90% reduction. In addition, the removal of ammonium nitrate has been required in a few cases. The present treatment methods satisfy the current needs in most cases, whereas the operation possibilities and the management of plants frequently are unsatisfactory. Leakage water in sewer systems frequently deteriorates treatment results. Improvement of wastewater treatment usually requires renovation of sewer system networks, which is a major goal in municipal water pollution control. (Moore-IVI)
W85-02393

IMPROVED METHODS OF DESIGNING FILTER BOXES,
Camp, Dresser and McKee, Inc., Walnut Creek, CA.
R. D. G. Monk.
Journal of the American Water Works Association, Vol. 76, No. 8, p 54-59, August, 1984. 10 Fig, 2 Ref.

Descriptors: *Design criteria, *Hydraulics, *Filters, *Head loss, Filtration, Filter boxes, Weirs, Pressures, Cost factors.

An understanding of the hydraulics of filters, combined with calculations of fixed head losses and information obtained from pilot studies, permits use of shallower filter boxes that are therefore more economical. Where appropriate, side backwash channels may further help reduce the cost of constructing filter boxes. To avoid the operating conditions that result when all of the head loss occurs in the top few inches of the media, piezometer taps and a manometer board for one filter would be of help. This equipment also helps in showing operators what is occurring within a filter, in identifying when attrition is occurring and when surface scalping would be justified, in ensuring that the correct dosage of filter aid is being applied, and in determining if a higher rate of filtration could be applied to drive the floc deeper into the media without jeopardizing water quality. An even better method would be to plot progressive advances of head losses during the filter run by means of a data logger so that head-loss curves could be displayed on a cathode ray tube. (Baker-IVI)
W85-02401

REMOVAL OF NITROGEN FROM INDUSTRIAL WASTEWATERS WITH THE USE OF ALGAL ROTATING DISKS AND DENITRIFICATION PACKED BED REACTOR,
Warsaw Univ., Poland, Dept. of Environmental Microbiology.
M. Przytocka-Jusiak, M. Blaszczyk, E. Kosinska, and A. Bisz-Konarzewska.
Water Research, Vol. 18, No. 9, p 1077-1082, 1984. 5 Fig, 1 Tab, 13 Ref.

Descriptors: *Wastewater treatment, *Nitrogen, *Purification, *Bacteria, Stichococcus, Industrial wastes, Denitrification, Nitrogen removal, Algae.

A previously proposed method for the two step biological purification of nitrogenous wastewater has been optimized. This study deals with the possibility of using Stichococcus bacillaris cultures on rotating disks for the purification of nitrogenous wastewaters and the utility value of algal biomass produced in purified wastewater as a source of carbon for denitrifying bacteria. S. bacillaris formed a compact biological film on the surface of rotating disks working in wastewater from the nitrogen industry. In stationary culture ammonium was removed first, followed by nitrites. All the nitrate nitrogen remained in the wastewater until the end of the experiment, i.e., spontaneous peeling off of the biological film. The removal of nitrogen from nitrogenous wastewater during 40 days of rotating disk operation with different retention times of the wastewater is presented. The removal from the wastewater of the different forms of nitrogen in packed bed reactor and algal rotating disks are given as means from the results obtained during 35 days operation of both systems joined in series with three series of wastewaters carrying different loads. The packed bed denitrification reactor removed all the nitrate and nitrite nitrogen from the wastewater providing they were enriched in the appropriate amount of methanol. The possibility of the use of algal biomass produced in the wastewater for such purposes seems to have a great economical advantage. (Baker-IVI)
W85-02425

PRECIPITATION OF PHOSPHORUS FROM WASTEWATER THROUGH PH VARIATION IN THE PRESENCE AND ABSENCE OF COAGULANTS,
McMaster Univ., Hamilton (Ontario). Dept. of Chemical Engineering.
E. Diamadopoulos, and A. Benedek.
Water Research, Vol. 18, No. 9, p 1175-1179, 1984. 10 Fig, 1 Tab, 10 Ref.

Descriptors: *Wastewater treatment, *Activated sludge process, *Phosphorus removal, *Calcium, *Aluminum, Acidity, Sludge, Coagulants.

Interactions between calcium and phosphorus in the activated sludge process were investigated. Any possible influence these interactions might have on the removal of phosphorus by aluminum were also considered. Variations of the pH of two activated sludges resulted in variations of the levels of calcium and phosphorus. Lowering the pH resulted in the release of these species into the solution, while increasing the pH led to their removal from the solution. Phosphorus and calcium, naturally present in the wastewater, formed an inorganic precipitate, which is entrapped in the biological flocs of the activated sludge system. For both systems studied, the stoichiometric molar ratio Ca:P in the calcium phosphate was found to be 2.

Removal of phosphorus from wastewater by the addition of aluminum coagulants to the aeration tank depends also on the parallel activity of calcium. The addition of a coagulant changed the nature of the supernatant suspended solids from biological to chemical. The supernatant suspended solids concentration in the case of coagulant addition was sensitive to variations in pH and exhibited a maximum value at around pH 8 where neither Al nor Ca were very effective. The particulate phosphorus concentration in the supernatant liquid when coagulants were used followed the same trend as the supernatant suspended solid. This also indicates the inorganic nature of the supernatant suspended solids in the case of the coagulant addition. (Baker-IVI)
W85-02438

MEASUREMENTS AND CONTROL OF DISSOLVED OXYGEN IN ACTIVATED SLUDGE PROCESSES,
R. Wilkes.
Water and Waste Treatment, Vol. 27, No. 7, p 32-34, July, 1984. 2 Fig.

Descriptors: *Dissolved oxygen, *Wastewater treatment, *Activated sludge process, Aeration, Computers, Secondary wastewater treatment, Automation.

Some 60% of all sewage in the United Kingdom receiving secondary treatment is treated in Activated Sludge Plants. The balance is mainly the percolating biological filter process. The present trend in treatment plants is towards low or no maintenance operating requirements. Systems which automatically clean themselves or check their own calibration are becoming necessary. The level of residual aeration on many plants varies from place to place within the aeration bay. Control of aeration can be by general control of total oxygen input. demands. During the last few years, the technique of using denitrification zones, or anoxic zones, has become more widely accepted. More and more use is made of programmable logic controllers for multiple control loop systems. Analogue type controls still provide the easiest way to set up or adjust systems, and these, combined with the power and versatility of the micro, will provide systems with multi function capabilities. (Baker-IVI)
W85-02487

INDUSTRIAL WASTE TREATMENT PILOT PLANTS,
Brown and Caldwell, Westwood, NJ.
V. C. D'Aco, and G. R. Campbell.
Chemical Engineering Progress, Vol. 80, No. 9, p 45-48, September, 1984. 2 Fig, 2 Ref.

Descriptors: *Pilot plants, *Wastewater treatment, Design criteria, Management, Decision making.

Pilot scale wastewater treatment systems will find increasing application as the Environmental Protection Agency promulgates the new BAT/BCT effluent limitations. Pilot systems can provide most of the key design criteria required to design a full-scale system to meet predefined performance objectives. The primary justification for conducting a pilot study is to minimize total project costs by reducing conservatism in design and to minimize risk by providing a firm basis for design. A decision to proceed with pilot testing must ultimately be made within the context of these objectives. For a pilot study to be successful, project objectives and planning should be carefully examined. In addition to design of the physical facilities, the project manager must consider sample requirements, analytical techniques, laboratory support, and data management procedures. In essence he must design a complete program, encompassing facilities and procedures within the time and budget constraints imposed by the overall project. The program and the project manager must be flexible enough to respond and adapt to new information and problems which will surface during the pilot study. (Baker-IVI)
W85-02550

CONCURRENT DEVELOPMENT OF AN INDUSTRIAL WASTE PRETREATMENT PROGRAM AND RESIDUAL SOLIDS MANAGEMENT PLAN,
CH2M/Hill, Denver, CO.
D. M. Wilson, T. J. Heinemann, F. Erwin, and F. Canahl.
Journal of the Water Pollution Control Federation, Vol. 56, No. 88, p 928-935, August, 1984. 7 Fig, 4 Tab, 2 Ref.

Descriptors: *Residual solids, *Industrial wastes, *Wastewater treatment, *Sludge, *Tulsa, *Oklahoma, Water quality control, Management, Sludge disposal.

Because of the reciprocal impacts of the Residual Solids Management Plan and the Industrial Wastes Pretreatment Program, for the City of Tulsa, they could not be accomplished independently. A strong technological base was developed as a basis for these decisions. This process resulted in a common-sense approach to industrial waste pretreatment, which was acceptable to the industrial community, while allowing the opportunity for sludge management goals to be met by pursuing a beneficial use of the residual solids. Common sense and judgement are needed to meet industrial pretreatment and sludge disposal goals that are compatible. A backup sludge disposal approach should be developed if there is any chance that the primary elements of the management plan for residual solids disposal will not be fully implemented. Industrial waste pretreatment cannot be relied upon as being a sufficient guarantee for sludge quality. (Baker-IVI)
W85-02572

SOIL-AQUIFER TREATMENT - A NEW APPROACH TO AN OLD METHOD OF WASTEWATER REUSE,
Tahal Consulting Engineers Ltd., Tel-Aviv (Israel).
E. Idelovitch, and M. Michail.
Journal of the Water Pollution Control Federation, Vol. 56, No. 8, p 936-943, August, 1984. 12 Fig, 6 Tab, 22 Ref.

Descriptors: *Water reuse, *Wastewater renovation, *Wastewater treatment, *Soil-aquifer treatment, Nitrification, Bacteria, Viruses, Land application, Groundwater recharge.

The soil-aquifer system can be used efficiently as a wastewater treatment plant. The complex physicochemical and biological processes occurring in the unsaturated zone and in the aquifer include: filtration, chemical precipitation, adsorption, cation exchange, biodegradation of organics, nitrification, denitrification, biological recarbonation, bacterial die-off, and virus inactivation. The lifetime of the physicochemical processes varies from short (removal of sodium and boron) to very long (removal of trace elements). The filtration effect of the upper soil layer and the biological processes can be effective indefinitely if the recharge operation is carefully managed. Soil-aquifer treatment (SAT) should be recognized as a modern approach to an old method of wastewater treatment and reuse, which involves low costs and simple operation. Besides its reliability with respect to effluent purification, it can also fulfill the function of seasonal and multi-annual water storage. Whenever feasible, SAT should be adopted and regarded as the nucleus of the wastewater treatment plant or reuse scheme, to be complemented when necessary, by suitable pretreatment, and post-treatment. (Baker-IVI)
W85-02573

TERTIARY FILTRATION: PRACTICAL DESIGN CONSIDERATIONS,
Montgomery (James M.), Inc., Pasadena, CA.
R. C. Siemak.
Journal of the Water Pollution Control Federation, Vol. 56, No. 8, p 944-949, August, 1984. 7 Fig, 4 Tab, 6 Ref.

Descriptors: *Wastewater treatment, *Filtration, *Tertiary wastewater treatment, *California, Sedimentation, Design criteria, Planning, Management.

Specific areas of concern related to tertiary filtration installations in the southern California area include media design, filter washing systems, chemical requirements, instrumentation and alarm provisions, and special considerations including upstream reliability. A good understanding of potable and tertiary filtration systems will aid the design engineer in making proper choices such as media selection, underdrain and backwash system design, and chemical system design. Proper filter media will provide consistent water quality and good operational characteristics. For tertiary applications, both water/surface wash and water/air scour systems are used. Average turbidity removal was approximately 50% with minimal chemical addition and improved to approximately 70% with chemical optimization for influent turbidity of 3 to 4 units. Attention to upstream secondary process reliability ensures that the tertiary filters perform properly and meet effluent quality goals. Secondary process optimization, chemical addition to final sedimentation tanks, and flow equalization are effective methods for maintaining upstream reliability. (Baker-IVI)
W85-02574

EFFECT OF PLASTIC MEDIA CONFIGURATION ON TRICKLING FILTER PERFORMANCE,
Brown and Caldwell, Walnut Creek, CA.
D. S. Parker, and D. T. Merrill.
Journal of the Water Pollution Control Federation, Vol. 56, No. 8, p 955-961, August, 1984. 10 Fig, 15 Ref.

Descriptors: *Wastewater treatment, *Trickling filters, Filtration, Design criteria, Plastic filter, Filter media, Solids contact.

A pilot investigation of the trickling filter/solids contact (TF/SC) process provided an opportunity to compare the performance of two types of corrugated sheet media. The modified Velz equation, a trickling filter design equation, was used to compare dissolved BOD5 removal characteristics of cross-flow and vertical media. Results indicated that cross-flow media had significantly higher reaction rate coefficients than vertical media. Moreover, parallel tests showed that the cross-flow media could accept 67% more load than the vertical flow media while producing effluent with the same dissolved BOD5. The superior performance of the cross-flow media was attributed primarily to higher oxygen transfer efficiency. Most of the dissolved BOD5 removal occurred in the top zone of the trickling filter which was limited by oxygen transfer efficiency. The cross-filter media has more interruptions in the film flow and, therefore, a higher oxygen transfer efficiency. The superior performance of the cross-flow media can significantly reduce trickling filter structural and media requirements for the TF/SC process which increases the cost advantages of the TF/SC process over conventional treatment processes. (Baker-IVI)
W85-02576

USE OF COAGULANTS TO TREAT SEAFOOD PROCESSING WASTEWATERS,
Alaska Univ., Fairbanks. Dept. of Environmental Quality Engineering.
R. A. Johnson, and S. M. Gallanger.
Journal of the Water Pollution Control Federation, Vol. 56, No. 8, p 970-976, August, 1984. 5 Fig, 5 Tab, 25 Ref. NOAA project R/35-03, grant NA81AA-D-00009.

Descriptors: *Wastewater treatment, *Food processing industry, Suspended solids, Coagulants, Acidity, Pilot plants.

A study was made of suspended solids removal from seafood processing wastewater. The initial phase involved a series of lab and pilot plant tests using hydrocyclone as solids-liquid separation devices. The hydrocyclones followed by coagulant addition and dewatering can produce a clarified effluent low in particulates and concentrate TSS by a factor of approximately 100. Chitosan and ferric sulfate were effective coagulants for crab, salmon, and shrimp processing wastewaters. The

proposed system may not be economical for Alaskan processors, but changes in the by-product market can alter this conclusion. (Baker-IVI)
W85-02578

INDUSTRIAL WASTEWATER TREATMENT WITH WATER REUSE AT A COAL-FIRED GENERATING STATION,
Gilbert/Commonwealth, Reading, PA.
J. F. Wagner, C. R. Kertell, and T. E. Strittmatter.
Journal of the Water Pollution Control Federation, Vol. 56, No. 8, p 977-982, August, 1984. 4 Fig, 5 Tab.

Descriptors: *Wastewater treatment, *Ash, *Seward Station, *Pennsylvania, Industrial waste, Powerplants.

Wastewater studies were performed in 1976 at Seward Station, Pennsylvania, in preparation for upgrading the waste treatment system. The present station consists of three coal-fired boilers and two turbine with a total rated capacity of 200 MW. The studies consisted of flow determination, discharge sampling and analyses, laboratory-scale treatability tests, waste collection schemes, conceptual treatment design and a preliminary report. The study recommended construction of a waste treatment and ash handling system which began in July 1978, and was completed in December 1980. Since the waste treatment facility start-up the plant has performed very well with minimal operator attention. There have been no problems that required additional engineering services other than normal plant maintenance. There have been no reports of operational problems or discharges that were not in compliance. Limits for suspended solids, pH, oil and grease and temperature analyses of the discharge to the Conemaugh River have been successfully met. (Baker-IVI)
W85-02579

ACHIEVING WASTEWATER COMPLIANCE WITH REDUCED GRANT SUPPORT,
Process Applications, Inc., Fort Collins, CO.
B. A. Hegg, J. R. Schultz, C. S. Zickefoose, and F. Matter.
Journal of the Water Pollution Control Federation, Vol. 56, No. 9, p 1007-1013, September, 1984. 5 Tab, 13 Ref.

Descriptors: *Wastewater treatment, *Management, Water quality control, Compliance, Financing.

The applicability of a plant-specific aproach for improving publicly owned wastewater treatment works (POTW) performance and compliance was completed. The results indicate that competing priorities prevent owners and administrators from gaining a clear focus and understanding of the performance objective of their wastewater treatment facilities. The required clarity has been masked by the complex interrelationship that exists between regulatory agency activities and local community reactions. This relationship involves the broad areas of technical assistance, construction grants, and enforcement. Focusing local priorities on achieving adequate treatment must be supplemented with an awareness of a probable need for increased local financial responsibility. (Baker-IVI)
W85-02582

NITRITE BUILD-UP IN ACTIVATED SLUDGE RESULTING FROM TEMPERATURE EFFECTS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
C. W. Randall, and D. Buth.
Journal of the Water Pollution Control Federation, Vol. 56, No. 9, p 1039-1044, September, 1984. 3 Fig, 5 Tab, 16 Ref.

Descriptors: *Nitrites, *Temperature effects, *Activated sludge process, *Nitrification, Wastewater treatment, Nitrates, Sludge.

Factors which suppress nitrification in the activated sludge process and, in particular, factors that have a greater impact on nitrate formation than on nitrite formation, were investigated. Temperature had a greater effect on nitrate formation than on nitrite formation, giving rise to a critical temperature for each system studied at which the rate of nitrite formation exceeds the rate of nitrate formation. Under these circumstances, the formation of nitrate becomes the rate-controlling step. The apparent critical temperatures for the laboratory-scale and full-scale reactors were different, 14 and 12 C, respectively. Different temperatures for nitrification failure have been reported. The reason for the difference in critical or failure temperatures is not fully understood, but probably results from chemical differences in the supernatant, especially pH. It is also possible that the dominant nitrification species differ from plant to plant, and they have differing temperature requirements, which results in different critical temperatures. (Baker-IVI)
W85-02585

NITRITE BUILD-UP IN ACTIVATED SLUDGE RESULTING FROM COMBINED TEMPERATURE AND TOXICITY EFFECTS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
C. W. Randall, and D. Buth.
Journal of the Water Pollution Control Federation, Vol. 56, No. 9, p 1045-1049, September, 1984. 4 Fig, 3 Tab, 17 Ref.

Descriptors: *Activated sludge process, *Nitrite, *Temperature effects, *Nickel, Metals, Toxicity, Wastewater treatment, Sludge, Nitrification.

The combined effects of temperature and toxicity on nitrification were examined, specifically to determine whether or not a synergistic inhibitory effect could be demonstrated. Data from other full-scale plants indicated that the initial inhibitory effect could be an increase in effluent nitrite concentration. The addition of nickel proved more toxic to nitrate formers than to nitrite formers and its presence at moderate concentrations could result in a build-up of nitrites in activated sludge systems. The inhibitory effects of nickel on nitrification was greater at 14 C than at 17 or 30 C. Therefore, there is a synergistic inhibitory effect between temperature and nickel toxicity for nitrification. The toxic effects of nickel on activated sludge should be evaluated on the basis of the nickel-to-MLVSS (mixed liquor volatile suspended solids) ratio rather than the concentration of the nickel alone. (Baker-IVI)
W85-02586

NITRIFICATION OF ANAEROBICALLY TREATED COAL GASIFIER EFFLUENT,
Georgia Inst. of Tech., Atlanta. Dept. of Civil Engineering.
F. Lu, W. H. Cross, E. S. K. Chian, F. G. Pohland, and H. Gao.
Journal of the Water Pollution Control Federation, Vol. 56, No. 9, p 1050-1058, September, 1984. 5 Fig, 4 Tab, 24 Ref. DOE grant DE-AC18-81FC10297.

Descriptors: *Nitrification, *Wastewater treatment, *Ammonia, *Coal gasification, Anaerobic conditions.

A biological nitrification process was evaluated for removal of high concentrations of ammonia from anaerobically treated coal gasifier effluent. The single stage activated sludge nitrification system was successfully used for the removal of ammonia-nitrogen from the effluent of the anaerobic filter treating 10% coal gasification wastewater containing as much as 601 mg total Kjeldahl nitrogen (TKN)/L. Performance of the nitrification system was significantly dependent on the effluent quality of the anaerobic fluidized bed activated carbon filter. Under the normal 31 day solids retention time (SRT) and loadings of 0.15 kg ammonia-N/kg MLVSS/day and 0.35 kg COD/kg MLVSS/day, removals of 97% TKN, 91% TOC and 95% COD were achieved. For effective nitrification of the coal gasification wastewater, solids retention time should be more than 22 days. Residual phenol and o-cresol could be completely removed in the nitrification system in all cases, but m-cresol and p-cresol removal depended on their influent concentrations. Addition of powdered activated carbon to the nitrification system or periodic replacement of a portion of granular activated carbon in the anaerobic filter removed or reduced the concentration of the inhibitory compounds and eliminated inhibition of nitrification. Nitrogen balances indicated that the total effluent nitrogen accounted for 90.2% of influent TKN; the unaccounted nitrogen was attributed to microbial cell growth requirements and possible losses from denitrification, air stripping, and analytic error. Alkalinity consumption averaged 5.8 mg alkalinity consumed/mg ammonia-nitrogen removed. (Baker-IVI)
W85-02587

WASTEWATER TREATMENT WITH AQUATIC PLANTS: ECOTYPIC DIFFERENTIATION OF TYPHA DOMINGENSIS SEEDLINGS,
Commonwealth Scientific and Industrial Research Organization, Griffith (Australia). Centre for Irrigation Research.
I. von Oertzen, and C. M. Finlayson.
Environmental Pollution (Series A), Vol. 35, No. 3, p 259-269, 1984. 3 Fig, 3 Tab, 23 Ref.

Descriptors: *Cattails, *Salinity, *Biological wastewater treatment, Aquatic plants, Calcium, Magnesium, Plant growth, Potassium, Phosphorus, Nitrogen.

As part of a program to determine the ability of aquatic plants to treat saline wastewater, the NaCl tolerance of seedlings from two populations of Typha domingensis was examined under glasshouse conditions. One population (Coorow) came from an NaCl-affected area while the second (Mitta Mitta Bore) was from an area affected by Ca and Mg salts. The Coorow seedlings grew better than those from Mitta Mitta Bore under an NaCl range of 0 to 50 mm, with most growth occurring at 10 and 25 mM NaCl. The experiment showed that ecotype differences in response to NaCl occur, but did not determine the upper level of tolerance of either population. While increased plant succulence was recorded, decreased leaf:root ratios were not. While there was a decrease in the K, N, and P contents of the plant tissues the NaCl contents increased. The K, N, and P values were, however, still relatively high. (Author's abstract)
W85-02590

EVALUATION OF M-T7 AGAR AS A FECAL COLIFORM MEDIUM,
Montana State Univ., Bozeman. Dept. of Microbiology.
For primary bibliographic entry see Field 5A.
W85-02598

5E. Ultimate Disposal Of Wastes

NATIONAL SURVEY OF ELEMENTS AND OTHER CONSTITUENTS IN MUNICIPAL SEWAGE SLUDGES,
Pennsylvania State Univ., University Park. Pesticide Research Lab.
R. O. Mumma, D. C. Raupach, J. P. Waldman, S. S. C. Tong, and M. L. Jacobs.
Archives of Environmental Contamination and Toxicology, Vol. 13, No. 1, p 75-83, January, 1984. 3 Tab, 30 Ref.

Descriptors: *Sludge, *Polychlorinated biphenyls, *Metals, *Nitrosamines, Gamma radiation, Hydrogen ion concentration, Calcium, Iron, Wastewater treatment, Carcinogens, Land disposal, Sludge disposal, Heavy metals.

Fifty-nine elements, polychlorinated biphenyls, volatile N-nitrosamines and gamma emission were determined in 30 sewage sludges from 23 American cities using several analytical methods. Relatively high concentrations of toxic metals were found in sludges from specific municipal plants. The pH and levels of calcium and iron in certain of the sludges appeared to reflect the addition of lime, ferric chloride and/or spent pickle liquor during sewage treatment. Of 15 sludges analyzed, the carcinogen, N-nitrosodimethylamine was detected in

14 and various other N-nitrosamines in 12 of them. Based on present federal guidelines, only 7 of the 30 municipal sludges analyzed would be considered suitable for land application owing to their elevated content of one or more heavy metals. (Author's abstract)
W85-02192

SEWAGE SLUDGE FOR CULTIVATING FRESHWATER ALGAE AND THE FATE OF HEAVY METAL AT HIGHER TROPHIC ORGANISMS; IV. HEAVY METAL CONTENTS IN DIFFERENT TROPHIC LEVELS,
Chinese Univ. of Hong Kong, Shatin. Dept. of Biology.
M. H. Wong, and F. Y. Tam.
Archiv fur Hydrobiologie, Vol. 100, No. 4, p 423-430, July, 1984. 1 Tab, 34 Ref.

Descriptors: *Sludge disposal, *Heavy metals, *Algal growth, Trophic level, Sludge, Manganese, Iron, Copper, Zinc, Pesticides, Recycling, Carp, Shrimp.

Aqueous extracts of sewage sludge were able to support excellent growth of the unicellular green alga, Chlorella pyrenoidosa with a high protein content. Although sludge-grown algae accumulated a substantial amount of various heavy metals (Mn, Fe, Cu, and Zn), organisms in the high trophic level (Caridina sp., freshwater shrimp and Cyprinus carpio, common carp) did not concentrate these metals. Possible transference of other toxic substances, such as pesticides, must also be considered in using waste materials for such purposes. It may be possible to cultivate algae directly in the sewage ponds or sludge settling ponds. This process may reduce time, space and effort being spent in the operations of sludge extraction and the establishment of new culture tanks. Perhaps shrimp or fish could also be reared in the same tank used for algal culture. Another alternative is to add sewage sludge into fish ponds as fertilizer for enriching the nutrient contents, accelerating algal growth and subsequently leading to higher fish yield via other organisms such as rotifers and crustaceans. Recycling of organic wastes for producing edible protein would be highly desirable in the future. (Baker-IVI)
W85-02237

EVALUATING ENCLOSED COMPOSTING SYSTEMS,
Metcalf and Eddy of New York, NY.
J. Anderson, M. Ponte, S. Biuso, D. Brailey, and J. Kantorek.
BioCycle, Vol. 25, No. 5, p 20-25, July-August, 1984. 5 Fig.

Descriptors: *Financial aspects, *Sludge disposal, *Composting, Odor control, Waste management.

The most cost effective solution to a sludge management problem existing in Clinton County and the City of Plattsburgh, New York was to use the open static pile method. Residents were opposed due to possible odor and dust problems. An enclosed composting system was viewed as necessary. Composting systems investigated included agitated solids bed system, silo systems, tunnel systems, and enclosed static pile. The functional analysis carried out considered the following points: total cost, quality of finished compost, operational experience, mechanical reliability, process control/reliability/flexibility, worker comfort, flexibility for future expansion, and aesthetic impact. The agitated bed type system was identified as the recommended process alternative. The two sub-alternatives of this process were reviewed - the circular and rectangular bin configurations. Due to the requirement of an enclosed system, a significant installed cost advantage was observed for enclosing the circular configuration, using a one piece geodesic dome. Thus the circular agitated bed system was recommended on the basis of this cost advantage. (Baker-IVI)
W85-02299

ECONOMIC COMPARISON OF COMPOSTING AND DUAL UTILIZATION,
R. D. Kuchenrither, W. J. Martin, D. G. Smith, and P. J. Psaris.
BioCycle, Vol. 25, No. 5, p 33-37, July-August, 1984. 10 Tab.

Descriptors: *Wastewater treatment, *Sludge disposal, *Denver, *Colorado, Composting, Economic factors, Decision making, Planning, Evaluation, Anaerobic conditions, Land disposal, Dual utilization.

The Metropolitan Denver Sewage Disposal District No. 1 provides wastewater treatment for approximately 1.5 million people. In 1983 the District adopted a dual utilization approach consisting of a multifaceted plan with two disposal alternatives: application of thickened, anaerobically digested sludge to agricultural land during the spring, summer, and fall; and windrow composting during the winter and periods of inclement weather. The selection of dual utilization was based on the recommendations of a sludge management plan which evaluated several sludge disposal alternatives for handling 100 dry tons of anaerobically digested sludge per year. These alternatives included dual utilization, windrow composting, land application with winter storage and incineration. The costs of additional equipment make the unit capital costs for dual utilization higher than those for composting. The operating costs for dual utilization are less than those of year round composting. Maintenance costs for dual utilization are more than double those for composting. The overall cost is approximately 10% less with composting than dual utilization. Increased reliability and flexibility plus the usefulness of a land application program made the choice swing to dual utilization. (Baker-IVI)
W85-02300

USING PILOT PLANTS TO DESIGN FACILITIES,
Camp, Dresser and McKee, Inc., Boston, MA.
J. F. Donovan, and D. F. Young.
BioCycle, Vol. 25, No. 5, p 46-48, July-August, 1984. 4 Fig.

Descriptors: *Pilot plants, *Decision making, *Planning, *Wastewater treatment, Composting, Aeration, Sludge disposal.

Pilot plant studies can be an effective method of improving the design of composting facilities. In Mansfield, Massachusetts a 3 mgd advanced wastewater treatment facility designed for seasonal nitrification and phosphorus removal is now under construction, to be operational in the spring of 1986. In November 1981 pilot composting studies were undertaken. The first study used filter pressed cake from a treatment plant with similar wastewater and sludge processes. The pilot test revealed that the shredder and the front-end loader were not appropriate devices for breaking up filter pressed cake. The tests also showed that despite inadequate mixing of sludge cake and woodchips, adequate temperature could be achieved with careful control of aeration rates. As a result of additional pilot tests, a materials balance was developed for the proposed facility. In Barrington, Rhode Island pilot tests showed that the planned mix of woodchips and sludge was good and exhibited a high void ratio that should aid in aeration. In Amherst, Massachusetts, a composting feasibility study resulted in a pilot program which showed that the compost product would probably qualify for a Type I classification under the State's land application regulation. A marketing survey was then conducted which revealed definite interest in that area for a compost like material. (Baker-IVI)
W85-02302

STABILIZATION OF SLUDGE FROM AN OXIDATION DITCH,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
J. T. Novak, M. P. Eichelberger, S. K. Banerji, and J. Yaun.
Journal of the Water Pollution Control Federation, Vol. 56, No. 8, p 950-954, August, 1984. 1 Fig, 2 Tab, 6 Ref.

Descriptors: *Sludge, *Land disposal, *Stability, *Oxidation ditch, Waste disposal, Bioindicators, Aerobic digestion.

The stability of sludge from an oxidation ditch operated over a range of sludge ages was evaluated. The stability data could then be used to determine if waste sludge from high sludge age or extended air processes could be directly land applied, and if not, the amount of further processing needed to achieve stability. Waste sludge from an oxidation ditch became increasingly more stable with regard to putrescibility as the sludge age increased. Indicator organism levels were influenced primarily by the influent concentration rather than the process sludge age. The specific oxygen uptake rate was an excellent indicator of stability with regard to putrescibility. The volatile solids reduction parameter contained in the regulations is not reasonable and for sludges from high sludge age processes may be unattainable. Indicator organism reductions by aerobic digestion were erratic and unpredictable. To ensure a reduction of two orders of magnitude at 20 C, required aeration times in excess of 40 days. Indicator organism reductions were greatly decreased at low temperatures. (Baker-IVI)
W85-02575

SLUDGE DEWATERING AND DISPOSAL IN THE PULP AND PAPER INDUSTRY,
Crown Zellerbach Corp., Camas, WA.
H. R. Amberg.
Journal of the Water Pollution Control Federation, Vol. 56, No. 8, p 962-969, August, 1984. 2 Fig, 9 Tab, 6 Ref.

Descriptors: *Sludge dewatering, *Sludge disposal, *Wastewater treatment, Sludge processes, Land disposal, Landfills, Pulp and paper industry.

Over 95% of the US pulp and paper industry capacity receives primary and secondary treatment. Overall BOD and TSS removal exceeds 90%. One drawback is the large amount of primary and secondary sludges generated. The key to minimizing sludge disposal costs is the dewatering technology used. The most common mechanical dewatering technologies used by the industry include vacuum filters, belt presses and solid bowl centrifuges. There is a trend toward use of belt presses which can dewater secondary sludges to 12 to 14% solids, primary sludges to 35% solids, and primary/secondary sludge mixtures to 16 to 25% solids. Polymer costs for mechanical dewatering vary widely with sludge characterisics. About 87% of the pulp and paper mill sludges produced are land filled and 13% are disposed of by incineration, composting, sale, and land application. Total dewatering and disposal costs for pulp and paper mill sludges vary widely, but they can account for about 40 to 45% of total wastewater treatment plant costs. Although a number of innovative systems are being used, the most widely used disposal systems for the next 10 yr will be landfill, incineration, and land application. (Baker-IVI)
W85-02577

5F. Water Treatment and Quality Alteration

AEROMONAS SOBRIA IN CHLORINATED DRINKING WATER SUPPLIES,
Oregon State Univ., Corvallis. Dept. of Microbiology.
M. W. LeChevallier, T. M. Evans, R. J. Seidler, O. P. Daily, and B. R. Merrell.
Microbial Ecology, Vol. 8, No. 4, p 325-333, 1982. 1 Fig, 2 Tab, 28 Ref. NOAA grant 04-8-M01-71.

Descriptors: *Aeromonas, *Drinking water, *Chlorination, *Oregon, Coliforms, Pathogenic bacteria, Water temperature, Bacterial analysis, Public health, Standard plate count.

Aeromonas, which has some virulence-associated factors, may occur in distribution water when total coliforms are absent. Aeromonas sp. were recovered from over 27% of 183 chlorinated drinking water samples collected from the finished water

supply of an Oregon coastal community during an 18-month period. Aeromonas was most frequently recovered during the warmer months, May through October, when water temperatures ranged from 15-20 C. Sixteen of 20 isolates tested elicited a cytotoxic response by Y-1 mouse adrenal cells. None of the strains was either enterotoxigenic by the rabbit ligated ileal loop assay, exhibited piliation, or show significant mannose resistant adherence to human buccal cells. The Aeromonas isolates were identified as A. sobria and were resistant to ampicillin and susceptible to chloramphenicol, kanamycin, streptomycin, and tetracycline. Total coliform levels did not correlate with Aeromonas densities in distribution water. Over 89% of the samples containing Aeromonas were negative for coliforms by the most probable number technique. In one instance the number of Aeromonas was 1,900/100 ml, yet no coliforms could be detected by either the membrane filtration or most probable number techniques. A significant correlation ($P < .001$) existed between standard plate count levels and Aeromonas. When high densities of Aeromonas (>100 bacteria/100 ml) were found in drinking water, the standard plate count exceeded 100 organisms/ml in 79% of the samples. (Moore-IVI)
W85-02187

WATERBORNE TRANSMISSION OF CAMPYLOBACTER ENTERITIS,
Center for Infectious Diseases, Atlanta, GA. Div. of Bacterial Diseases.
D. N. Taylor, M. Brown, and K. T. McDermott.
Microbial Ecology, Vol. 8, No, 4, p 347-354, 1982. 31 Ref.

Descriptors: *Campylobacter, *Enteritis, *Epidemiology, *Wyoming, *Illinois, Public health, Pathogenic bacteria, Surface waters, Water distribution, Animals.

Campylobacter jejuni is an important cause of human diarrheal disease throughout the world and like Salmonella enteritidis, has a large animal reservoir which includes most of man's domestic animals. Until recently, it has been difficult to trace the chain of transmission from animals to man because of inadequate environmental sampling techniques and means to distinguish strains. Recent improvements in these techniques have made environmental studies more feasible in 2 water-related outbreaks. In 1 study, C. jejuni was found to be an important cause of sporadic, summertime diarrheal disease among hikers in national wilderness areas of Wyoming. In this setting, illness was significantly associated with drinking untreated surface water. Subsequently C. jejuni was isolated from surface water, including mountain streams, and from animals in the area. Some of the environmental isolates were serotypically identical to strains isolated from humans. A second occurred as a result of an outbreak of Campylobacter enteritis in a community in northern Illinois which was epidemiologically associated with the community water system. Campylobacter jejuni was isolated from several surface water sources and from the implicated water system. These studies demonstrate that environmental isolation of C. jejuni is now possible and may add to our understanding of disease transmission. (Author's abstract)
W85-02188

EVALUATION OF GIARDIA CYST REMOVAL VIA PORTABLE WATER FILTRATION DEVICES,
Michigan Univ., Ann Arbor. Dept. of Environmental and Industrial Health.
S. D. Schmidt, and P. G. Meier.
Journal of Freshwater Ecology, Vol. 2, No. 5, p 435-439, August, 1984. 2 Fig, 8 Ref.

Descriptors: *Filtration, *Water treatment, *Drinking water, *Giardia, Public health, Water quality control, Water treatment.

Evaluations were made of two portable water filtration devices for their effectiveness in removing potentially pathogenic Giardia cysts using a rigorous testing schedule that simulated in-field use. The portable filtration devices which were evaluated employ a silver-impregnated ceramic filter element of submicron porosity. The smaller, hand-held unit measures 25 cm in length, weights 650 g and is capable of filtering up to 0.75 liters of water per minute. The large device is 58 cm in length, weighs 4.9 kg and yields up to 8 liters per minute. Both are manually operated. No difficulties were encountered during the testing schedule in filtering the dense test challenge suspensions through the portable devices. Both the larger and smaller units were very efficient in retaining the Giardia cysts and other challenge protozoans. Direct evidence of cyst destruction during concentration/recovery of control preparations was observed. Centrifugal stress and inadvertent drying of membrane filters were most often responsible for control recoveries that averaged 66%. (Baker-IVI)
W85-02244

GAC TREATMENT COSTS: A SENSITIVITY ANALYSIS,
Environmental Protection Agency, Cincinnati, OH. Drinking Water Research Div.
R. M. Clark, R. G. Eilers, and B. W. Lykins, Jr.
Journal of Environmental Engineering, Vol. 110, No. 4, p 737-750, August, 1984. 9 Fig, 10 Tab, 7 Ref.

Descriptors: *Activated carbon, *Economic aspects, *Water treatment, Design criteria, Cost analysis, Drinking water.

Activated carbon is effective for removing a broad spectrum of organics from drinking water but is most effective for removing high molecular weight compounds. The sensitivity of granular activated carbon system costs to changes in certain operating variables is examined. Several variables have been identified as important. These include choice of system configuration, loading rate and size of system, reactivation frequency, interest rate and life of system, local construction and operating costs, inflation, and carbon use rate. With the help of the curves presented, these sensitivities can be studied. Based on this analysis any design changes that can use the capital invested in the system more efficiently will minimize the cost. For a given empty bed contact time, fewer contactors of greater volume yield minimum cost. Based on activated carbon use rate, however, bigger is not better. The relationship between activated carbon use rate, activated carbon loss and reactivation frequency must be studied carefully. Using a cheaper activated carbon with higher losses could mean increased activited carbon losses and more frequent reactivation. (Baker-IVI)
W85-02274

USE OF ZEOLITE TO REMOVE TOXIC SUBSTANCES FROM NITROGEN METABOLISM OF FISHES,
Moscow State Univ. (USSR). Dept. of Biology.
A. S. Konstantinov, and M. Yu. Pelipenko.
Journal of Ichthyology, Vol. 23, No. 6, p 159-161, 1983. 2 Tab, 8 Ref.

Descriptors: *Fish farming, *Nitrogen, *Adsorption, *Zeolite, Clinoptilolite, Nitrates, Nitrites, Carp, Danio.

In efforts to improve the quality of water for raising fishes, the efficiency of purifying water from nitrogenous compounds through their adsorption by zeolite was investigated. The experimental fish used were carp yearlings and immature striped danio. Clinoptilolite, one of the most common zeolites, was used as the adsorbent and was applied to the aquaria with carp and danio at the rate of 500 and 100 g. respectively. In the experiment with carp a chain of four aquaria was used which were connected with each other by a siphon. Nitrate and nitrite concentrations in aquarium no. 1 that had the purest water did not significantly increase over 30 days. In aquarium no. 2, concentration of both these nitrogenous compounds increased significantly and towards the end of the experiment, nitrite concentration was higher than OST standards. In the fourth aquarium receiving the largest quantity of both the nitrogenous compounds, but having the adsorbent in the bottom, nitrite and nitrate concentrations were almost at the same low level as in the first aquarium. The detoxification effect was clearly shown by the increase in fish growth rate. Similar results were observed in the experiments with danio. Apparently by absorbing ammonia salts, clinoptilolite inhibits formation of nitrates and nitrites as the products of catabolism of ionized ammonia and, thus, pollution by toxic products of nitrogen metabolism is greatly reduced. (Baker-IVI)
W85-02281

ELECTROANALYTICAL METHODS FOR MONITORING POTABILIZATION PROCESSES,
Florence Univ. (Italy). Inst. of Analytical Chemistry.
G. Piccardi.
Science of the Total Environment, Vol. 37, No. 1, p 101-105, July, 1984. 1 Tab. 21 Ref.

Descriptors: *Water analysis, *Potable water, *Water treatment, *Electrochemistry, Drinking water, Water quality control, Monitoring, Chlorine, Chlorine dioxide, Ozone, Hypochlorite, Chlorite, Potentiometry, Disinfection.

Potentiometric, amperometric and coulometric methods are evaluated for monitoring water potabilization processes. Water potabilization is carried out by the addition of a gas such as chlorine, chlorine dioxide, ozone or by the addition of a solution of hypochlorite or chlorite. The most widely used method for monitoring the potabilization process is the amperometric one in which the concentration is measured by the current flowing through a cell containing one polarized electrode. This current, as a first approximation, is proportional to the area of the cathode and to the potabilizing agent concentration and inversely proportional to the thickness of the diffusion layer. While not widely used, the coulometric method is also viable working under the flow analysis technique. The chlorine solution to be analyzed is placed into an electrolysis cell where it reacts quantitatively with Fe(II) that has been generated electrolytically from Fe(III) that has been added with a peristaltic pump. Substances oxidizing Fe(II) interfere in the determination of chlorine. The main problems still to be resolved in the use of electrochemical techniques are specificity and long term stability. (Baker-IVI)
W85-02313

THRESHOLD ODOUR CONCENTRATIONS OF ODOROUS ALGAL METABOLITES OCCURRING IN LAKE WATER,
Helsinki Univ. (Finland). Dept. of Limnology.
P.-E. Persson, and F. Juttner.
Aqua Fennica, Vol. 13, p 3-7, 1983. 2 Fig, 1 Tab, 25 Ref.

Descriptors: *Odor-producing algae, *Lakes, *Reservoirs, Odors, Organoleptic properties, Algae, beta-Cyclocitral, Trimethylcyclohexenone, Trimethylcyclohexanone, Trimethylcyclohexene, Octadiene, Methylpentenal, Drinking water, Water quality control.

Threshold odor concentrations in water were determined for beta-cyclocitral, 2,6,6-trimethylcyclohex-2-en-1-one, 2,2,6-trimethylcyclohexanone, 1,3,3-trimethylcyclohexene, octa-1,3-diene and 2-methylpent-2-enal. Each of these compounds occurs in natural waters and is of biogenic origin. The total organic carbon values obtained for each compound are presented along with the odor characteristics. The relationship between odor intensity and concentration of beta-cyclocitral is demonstrated. Beta-cyclocitral can be isolated from blooms of Microcystis wesenbergii. Minor concentrations have been found during blooms of Synura uvella. Octa-1,3-diene can be isolated from a culture of Asterionella formosa. 2-Methylpent-2-enal was detected in the odor concentrate isolated from water of the Haltern reservoir rich in Tetraselmis sp. (Baker-IVI)
W85-02389

REMOVAL OF SEDIMENT PARTICLES BY VORTEX BASIN,

Tampere Univ. of Technology (Finland).
For primary bibliographic entry see Field 8B.
W85-02391

HISTORY OF THE ATTEMPTED FEDERAL REGULATION REQUIRING GAC ADSORPTION FOR WATER TREATMENT,
Houston Univ., TX. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6E.
W85-02399

SURVEY OF PROBLEMS WITH REVERSE OSMOSIS WATER TREATMENT,
Tennessee Technological Univ., Cookeville.
T. N. Eisenberg, and E. J. Middlebrooks.
Journal of the American Water Works Association, Vol. 76, No. 8, p 44-49, August, 1984. 1 Fig, 2 Tab. 4 Ref.

Descriptors: *Water treatment, *Reverse osmosis, *Surveys, Membrane processes, Cost factors, Water treatment.

Operators of 28 reverse osmosis (RO) water treatment plants were surveyed to obtain information on the types and causes of problems with such treatment installations. Reasons given for closing RO plants were the availability of a municipal water supply, obtaining a better quality water source, the cost of membrane replacement, the high cost of producing quality water, and a change in feedwater quality as a result of failure in well construction. Water requirements ranged from 0.0015 to 16.3 ML/d (0.0004 to 4.3 mgd). Storage capacities, available at all sites, ranged from 0.76 to 18.9 ML to unlimited due to the underground injection possibility. Some 95% of the plants that reported using pretreatment added some type of chemical to treat the feedwater. Pumping requirements were met most frequently by centrifugal multistage process pumps. Feedwater electroconductivity ranged from 430 to 38,000 microS/cm. Cellulose acetate membranes were used at 15 sites (71%) and polyamide was used at 6 (29%). Methods of brine disposal varied with geographic location. Only one plant did not posttreat product water. Posttreatment disinfection was practiced at 17 (90%) of the plants. Decarbonation or degasification was performed at all 19 installations. (Baker-IVI)
W85-02400

DETERMINING INTERNAL CORROSION POTENTIAL IN WATER SUPPLY SYSTEMS (COMMITTEE REPORT).
Southern California Metropolitan Water District, Los Angeles.
Journal of the American Water Works Association, Vol. 76, No. 8, p 83-88, August, 1984. 1 Fig, 4 Tab, 5 Ref.

Descriptors: *Corrosion, *Water conveyance, *Drinking water, Water quality control, Decision making, Planning.

A method is presented for analyzing and evaluating the internal corrosion potential of water systems so that the purveyor can solve various problems of corrosion within a system. An initial evaluation is offered of the characteristics of a water supply along with laboratory analyses, field investigations, and the development of a corrosion control strategy. The report converts easily to a manual for community water system operators. It provides guidance in evaluating potential internal corrosion problems for water system operators with limited technical resources. (Baker-IVI)
W85-02403

ACCOUNTABILITY MANAGEMENT BRINGS REVENUE INCREASES,
Springfield City Water, Light and Power, IL.
For primary bibliographic entry see Field 6B.
W85-02486

EFFECT OF BAQUACIL ON PATHOGENIC FREE-LIVING AMOEBAE (PFLA) 3. INCREASED BAQUACIL CONCENTRATION AND EXPOSURE TIME IN THE PRESENCE OF BACTERIA,
Massey Univ., Palmerston North (New Zealand). Dept. of Microbiology and Genetics.
M. W. Dawson, T. J. Brown, C. J. Biddick, and D. G. Till.
New Zealand Journal of Marine and Freshwater Reseach, Vol. 18, No. 1, p 53-56, 1984. 4 Fig, 14 Ref.

Descriptors: *Disinfection, *Water treatment, *Baquacil, *Amoeba, *Bacteria, Water quality control, Chlorine.

Baquacil is being studied as an alternative pathogenic free-living amoebae disinfectant to chlorine. Baquacil was tested against axenic and monoxenically grown pathogenic free-living amoeba cultures (Naegleria and Acanthamoeba spp.) fed with bacteria. When the initial concentration of Baquacil and/or the exposure time were increased, survival rates were reduced. Monoxenically cultured amoebae created a greater Baquacil demand than amoebae grown axenically. No marked difference in sensitivity was apparent between Naegleria and Acanthamoeba spp. (Baker-IVI)
W85-02506

INACTIVATION OF NAEGLERIA AND GIARDIA CYSTS IN WATER BY OZONATION,
Ohio State Univ., Columbus. Dept. of Civil Engineering.
G. B. Wickramanayake, A. J. Rubin, and O. J. Sproul.
Journal of the Water Pollution Control Federation, Vol. 56, No. 8, p 983-988, August, 1984. 7 Fig, 4 Tab, 22 Ref. EPA grant R-808150-02-0.

Descriptors: *Water treatment, *Drinking water, *Ozonation, *Naegleria, *Giardia, Ozone, Disinfection, Water quality control, Protozoa, Public health, Water temperature, Hydrogen ion concentration.

The effect of ozone concentrations, at various pH and temperature regimes, on the rate and extent of inactivation of protozoan cycts was evaluated. Within the reported range of temperatures, pH, and ozone concentrations, the cyst inactivation kinetics deviated from Chick's law because there was an initial lag period. The rate of inactivation increased during this lag period and then declined where the inactivation rate was directly proportional to the number of viable cysts. At 99% inactivation, the results were well represented by Watson's law with the coefficient of dilution being close to one. Cysts of N. gruberi were more resistant to aqueous ozone than those of G. muris. With 0.2 mg/L of ozone at 25 C and pH 7, the contact times required for 99% kill were 7.5 and 1.05 minutes, respectively. Inactivation rates for both organisms in the pH range of 5 to 8 were not significantly different. At pH 9 ozone was relatively less effective for N. gruberi, whereas G. muris were more readily killed. The cysticidal effeciency of ozone increased with temperature. Ozone seemed more effective than free chlorine for cyst inactivation. Most of the protozoan cysts are more resistant than bacteria and viruses to ozone. In ozone disinfection at room temperature and neutral pH, G. muris cysts are comparable to viruses and bacteria that exhibit high resistance. (Baker-IVI)
W85-02580

EVIDENCE FOR THE ROLE OF COPPER IN THE INJURY PROCESS OF COLIFORM BACTERIA IN DRINKING WATER,
Montana State Univ., Bozeman. Dept. of Microbiology.
M. J. Domek, M. W. LeChevallier, S. C. Cameron, and G. A. McFeters.
Applied and Environmental Microbiology, Vol. 48, No. 2, p 289-293, August, 1984. 3 Fig, 3 Tab, 32 Ref. EPA grant R807092.

Descriptors: *Copper, *Bioindicators, *Coliforms, *Injured coliforms, *Drinking water, Cadmium, Lead, Heavy metals, Statistical models, Escherichia.

Low levels of copper in chlorine-free distribution water caused injury of coliform populations. Monitoring of 44 drinking water samples indicated that 64% of the coliform population was injured. Physical and chemical parameters were measured, including three heavy metals (Cu, Cd, and Pb). Copper concentrations were important, ranging from 0.007 to 0.54 mg/liter. Statistical analyses of these factors were used to develop a model to predict coliform injury. The model predicted almost 90% injury with copper concentration near the mean observed value (0.158 mg/liter) in distribution waters. Laboratory studies with copper concentrations of 0.025 and 0.050 mg/liter in an inorganic carbon buffer under controlled conditions of temperature and pH caused over 90% injury within 6 and 2 days, respectively. Studies of the metabolism of injured Escherichia coli cells indicated that the respiratory chain is at least one site of damage in injured cells. (Author's abstract)
W85-02594

ISOLATION OF AEROMONAS HYDROPHILA FROM A METROPOLITAN WATER SUPPLY: SEASONAL CORRELATION WITH CLINICAL ISOLATES,
Princess Margaret Children's Medical Research Foundation, Perth (Australia).
V. Burke, J. Robinson, M. Gracey, D. Peterson, and K. Partidge.
Applied and Environmental Microbiology, Vol. 48, No. 2, p 361-366, August, 1984. 7 Fig, 1 Tab, 29 Ref.

Descriptors: *Perth, *Australia, *Drinking water, *Aeromonas, Public health, Water treatment, Chlorination, Coliforms, Water temperature, Water quality standards, Pathogenic bacteria, Seasonal variation.

The occurrence of Aeromonas spp. in the metropolitan water supply of Perth, Western Australia, Australia, was monitored at several sampling points during a period of 1 year. Water within the distribution system conformed to international standards for drinking water but contained Aeromonas spp. in numbers comparable to those in raw surface water, although this water was free of Escherichia coli. Coliforms and E. coli were found in raw surface waters, and Aeromonas spp. were found in raw water from surface and underground sources. Chemical treatment, followed by chlorination at service reservoirs, resulted in water free of E. coli and a decrease in the number of Aeromonas spp. were found in the greatest numbers in summer. Multiple regression analysis that growth of Aeromonas spp. in chlorinated water was related to water temperature, residual chlorine, and interaction between these variables. The incidence of Aeromonas-associated gastroenteritis, determined from isolates referred for enterotoxin testing, paralleled the pattern of isolation of Aeromonus spp. in water within the distribution systems. It is suggested that the presence of Aeromonas spp. in drinking water needs public health appraisal and that further work should be undertaken to permit reevaluation of standards for the quality of drinking water. (Author's abstract)
W85-02596

ISOLATION OF AEROMONAS SPP. FROM AN UNCHLORINATED DOMESTIC WATER SUPPLY,
Princess Margaret Children's Medical Research Foundation, Perth (Australia).
V. Burke, J. Robinson, M. Gracey, D. Peterson, and N. Meyer.
Applied and Environmental Microbiology, Vol. 48, No. 2, p 367-370, August, 1984. 3 Fig, 24 Ref.

Descriptors: *Australia, *Aeromonas, *Drinking water, Coliforms, Escherichia, Public health, Pathogenic bacteria, Enterotoxins, Hemolysins.

The recovery of Aeromonas spp. from the unchlorinated water supply for a Western Australian city of 21,000 people was monitored at several sampling points during a period of 1 year. Membrane filtration techniques were used to count colonies of Aeromonas spp., coliforms, and Escherichia coli in water sampled before entry to service reservoirs, during storage in service reservoirs, and in distribution systems. Aeromonas spp.

were identified by subculture on blood agar with ampicillin, oxidase tests, and the use of Kaper medium and then were tested for production of enterotoxins and hemolysins. During the same period, two-thirds of all fecal specimens sent for microbiological examination were cultured on ampicillin-blood agar for Aeromonas spp. Recovery of Aeromonus spp. from water supplies at distribution points correlated with fecal isolations and continued during autumn and winter. Coliforms and E. coli were found most commonly in late summer to autumn. This pattern differs from the summer peak of Aeromonas isolations both from water and from patients with Aeromonas spp.-associated gastroenteritis in Perth, Western Australia, a city with a chlorinated domestic water supply. Of the Aeromonas strains from water, 61% were enterotoxigenic, and 64% produced hemolysins. (Author's abstract)
W85-02597

5G. Water Quality Control

UNITED STATES V. OSWEGO BARGE CORPORATION,
Goldstein (Seymour R.), Baltimore, MD.
For primary bibliographic entry see Field 6E.
W85-02177

OPTIMIZING PUMPING STRATEGIES FOR CONTAMINANT STUDIES AND REMEDIAL ACTIONS,
Robert S. Kerr Environmental Research Lab., Ada, OK.
J. F. Keely.
Ground Water Monitoring Review, Vol. 4, No. 3, p 63-74, 1984. 10 Fig, 6 Ref.

Descriptors: *Pumping wells, *Water pollution control, *Groundwater pollution, Groundwater movement, Flow rate, *Hydraulic gradient, Cone of depression, Wells, Pumping strategies.

One of the more common techniques for controlling the migration of contaminant plumes is the use of pumping wells to produce desired changes in local flow rates and hydraulic gradients. When seeking to optimize an array of pumping well locations and discharge rates, it is important to consider the effects that non-ideal aquifer conditions, well construction and demographic constraints produce. Heterogeneous and anisotropic aquifer conditions seriously complicate siting and discharge rate requirements for pumping wells because of the distorted cones of depression that result from withdrawing water in such settlings. Proper screen selection, gravel pack emplacement and well development are crucial factors affecting the operational characteristics and economics of pumping wells; these factors are generally recognized, though often undervalued. The impacts that well depth and diameter, and screen length and position have on the effectiveness of pumping efforts are also often undervalued, with detrimental consequences. Perhaps the most difficult problems to overcome in designing pumping schemes, however, are posed by demographic constraints. Denial of property access, vandalism and the unpredictability of nearby water supply and irrigation pumpage tend to wreak havoc with the best of pumping strategies. (Author's abstract)
W85-02217

DERIVATION OF ENVIRONMENTAL QUALITY OBJECTIVES AND STANDARDS FOR BLACK AND GREY LIST SUBSTANCES,
Water Research Centre, Stevenage (England).
G. Mance.
Chemistry and Industry, No. 14, p 509-512, July, 1984. 1 Fig, 2 Tab, 2 Ref.

Descriptors: *Standards, *Water quality control, *European Community, Water pollution control, Regulations, Heavy metals, Pesticides, Chlorinated hydrocarbons.

The derivation of environmental quality standards as derived from the European Community Dangerous Substances Directive is considered. The Directive is aimed at controlling the discharge of certain toxic substances to the aquatic environment, but it does not specify numeric standards. It identified two categories of substances: List I contains cadmium, mercury, and persistent organochlorine and organophosphorus pesticides. List II contains those metallic elements which are generally less toxic than cadmium and mercury, together with a number of other groups of substances such as plant nutrients and those exerting an oxygen demand. For List I the aim is the elimination of pollution caused by these substances. For List II the aim is to reduce pollution levels. For the common uses of surface waters, environmental quality standards are required for use in consenting discharges. These standards are intended to control pollution sources of pollutants and represent the maximum safe concentration of a particular substance applied at the edge of the area of initial dilution. An environmental quality objective was defined as the requirement that a body of water should be suitable for those uses identified by the controlling authority. Environmental quality standard was defined as that concentration of a substance which must not be exceeded if a specified use of the aquatic environment is to be maintained. In preparing recommendations for EQSs, or maximum safe concentrations, it has to be recognized that current understanding of the toxic effects of even the more commonly occurring dangerous substances is limited. (Baker-IVI)
W85-02227

LEACHATE COLLECTION SYSTEM PERFORMANCE ANALYSIS,
D'Appolonia Waste Management Services, Inc., Pittsburgh, PA.
D. J. Cosler, and R. E. Snow.
Journal of Geotechnical Engineering, Vol. 110, No. 8, p 1025-1041, August, 1984. 10 Fig, 2 Tab, 9 Ref.

Descriptors: *Leachates, *Collection systems, *Waste disposal, *Liners, Pressure, Filtration, Drainage, Hydraulic pressure, Computer models.

The sensitivity of a waste disposal impoundment's leachate collection system performance at a range of design parameter values is investigated based on a computer modeling study. The piezometric head distribution in a vertical cross section of the impoundment is simulated using the finite element method to solve the combined equation of motion and continuity for two-dimensional flow through a saturated anisotropic porous media. The design parameters studied included saturated waste depth, ground slope, underdrain spacing, and the hydraulic conductivities of the waste, clay liner, drainage blanket, and drain filter. Emphasis is placed on the effect of the design parameters on the hydraulic pressure distribution directly above the clay liner which underlies the waste. The three key parameters which appeared to control liner pressure are the drain spacing, the hydraulic conductivity of the drainage layer underlying the waste, and the hydraulic conductivity of the drain filter. The other parameters affect the hydraulic pressure distribution, but not as significantly. The results are directly appliable only for analyzing the future disposal of wastes which are not contained within a synthetic membrane or for evaluating the added protection that can be provided in synthetically lined impoundments to minimize the impacts of a liner rupture. (Baker-IVI)
W85-02261

TWO-DIMENSIONAL TIME-DEPENDENT SIMULATION OF CONTAMINANT TRANSPORT FROM A LANDFILL,
Miami Univ., Coral Gables, FL. Coll. of Engineering.
D. Dasgupta, S. Sengupta, K. V. Wong, and N. Nemerow.
Applied Mathematical Modelling, Vol. 8, No. 3, p 203-209, June, 1984. 10 Fig, 2 Tab, 11 Ref. DOE contract DE-AS05-78EV10133.

Descriptors: *Solute transport, *Model studies, *Landfills, Waste dumps, Leaching, Mathematical models, Public health.

In order to simulate solute transport in flowing groundwater a numerical model is developed using finite-difference solutions to the groundwater flow equation and the solute transport equation. The model is applied to problems of groundwater contamination in a waste-disposal area in Miami, Florida. Several factors that controlled changes in iron concentrations were successfully integrated by the model which successfully reproduced the record of contamination observed during a one-year period. The model was insensitive to chemical parameters, but sensitive to an aquifer dispersion coefficient and the groundwter flow velocity. This implies that there can be sites where the chemical attenuation can be approximated without a significant impact on results. (Baker-IVI)
W85-02272

LAKE RESTORATION BY BIOMANIPULATION: ROUND LAKE, MINNESOTA, THE FIRST TWO YEARS,
Minnesota Univ., Minneapolis. Limnological Research Center.
J. Shapiro, and D. I. Wright.
Freshwater Biology, Vol. 14, No. 4, p 371-383, August, 1984. 6 Fig, 2 Tab, 39 Ref.

Descriptors: *Round Lake, *Minnesota, *Lake restoration, *Biomanipulation, *Rotenone, Fish control agents, Rehabilitation, Phytoplankton, Population density, Transparency, Chlorophyll a, Daphnia, Nitrogen, Phosphorus, Grazing pressure.

Rotenone was applied to Round Lake in the autumn of 1980 in order to eliminate predominantly planktivorous and benthivorous fish. The lake was subsequently restocked with higher population density of piscivores. The effect of this biomanipulation on the phytoplankton and zooplankton communities and on total nutrient concentrations was monitored at fortnightly intervals during the summers, from May 1980 to September 1982. The abundance of phytoplankton was much lower after biomanipulation and was consistent with observed changes in secchi disc transparency, total attenuation coefficient and chlorophyll a concentration. Zooplankters were also less abundant in 1981 and 1982 but the decrease in numbers was more than offset by the large increase in the mean sizes of the zooplankters present, so that the estimated grazing pressures in 1981 and 1982 were at least double the 1980 value. Daphnia, rare in 1980, became the dominant genus in 1981 and 1982, and a shift to progressively larger-bodied Daphnia species was observed. Although total nitrogen and total phosphorus levels generally lower after biomanipulation, their decline could not explain the reduction in phytoplankton abundance which was attributed to the increased grazing pressure. Possible causes of the observed declines in nutrient concentrations are discussed. (Author's abstract)
W85-02284

ATTEMPTS TO ALLEVIATE FISH LOSSES FROM ALLEGHENY RESERVOIR, PENNSYLVANIA AND NEW YORK, USING ACOUSTICS,
Corps of Engineers, Pittsburgh, PA. Pittsburgh District.
E. J. Smith, and J. K. Andersen.
North American Journal of Fisheries Management, Vol. 3, No. 3, p 300-307, 1984. 2 Fig, 3 Tab, 7 Ref.

Descriptors: *Allegheny Reservoir, *Pennsylvania, *New York, *Reservoir operation, *Fish conservation, *Acoustics, Reservoir storage, Fish behavior, Reservoirs, Reservoir fisheries.

As a consequence of pool drawdown each fall and winter to enhance flood storage, numerous fish are lost through the bottom sluices of Allegheny Reservoir (located on the western border of Pennsylvania and New York). The sudden release of pressure accompanying the passage of these fish from a deep zone of the reservoir into the tailrace can result in a substantial fish kill. The conditions under which fish are lost apparently are enhanced when the pool level is low and discharge is high. In an effort to reduce these losses, underwater broadcasts of recorded sound effects were tested. The sound projector was a low-frequency transducer mounted above the bottom sluices on the

upstream face of the dam. While the sound broadcasts were being evaluated, the Corps of Engineers maintained a higher winter pool at the project to test the effect of controlled flow releases on ice formation at downriver locations. Although the underwater sound broadcasts were not effective, maintenance of a higher winter pool resulted in a marked reduction in the fish losses. (Author's abstract)
W85-02373

EXPERIENCES GAINED IN RESTORING A WILDERNESS RIVER,
Kuopio Water District Office (Finland).
R. Porttikivi.
Aqua Fennica, Vol. 12, p 26-36, 1982. 5 Fig, 6 Ref.

Descriptors: *Vaikko River, *Finland, *River restoration, *Wilderness areas, Recreation, Fisheries, Rapids, Hydrology, Water quality, Boating, Costs, Habitat improvement, Landscaping.

The Vaikko River has its source in Eastern Finland and it is a part of the great Vuoksi River drainage basin. Due to channel works carried out for improving timber floating, which ceased in the beginning of the 1960's, the condition of the river for recreational and for fisheries use has been poor. At the initiative of the Kaavi commune in 1972 the development of the scenic river was started by the Water District Office of Kuopio. The objective of the restoration plan was to mitigate the adverse effects of the channel works and to improve rapids-shooting possibilities, to construct recreational facilities, to promote sport-fishing by enhancing fish habitat, and to form the Vaikko River into a central tourist attraction in the region. The implementation of the restoration started in 1979 and the last finishing and landscaping measures were accomplished in 1982. In the paper the project is described from the point of view of hydrology and water quality, boating, fisheries, outdoor recreation and camping. The total length of the restored river is 5.0 km and the total restored area 10.7 ha. Actual river restoration cost was 120.000 mk per kilometer and 6 mk per square meter. The costs are estimated to be returned in ten years. The skillful operation of working machines proved to be very important to obtaining good results in river bed modification work. The follow-up of the project is considered necessary for the sake of developing restoration methods for altered water bodies. The need for this kind of water resources development is evidently great. (Author's abstract)
W85-02386

LAKE MANAGEMENT AND RESTORATION,
Vesi-Eko Ky, Kuopio (Finland).
K. M. Lappalainen.
Aqua Fennica, Vol. 12, p 37-46, 1982. 4 Fig, 42 Ref.

Descriptors: *Lake management, *Lake restoration, *Phosphorus, *Finland, Oxygenation, Eutrophication, Lake sediments, Destratification, Hypolimnetic oxygenation, Lakes.

Phosphorus is the most limiting factor in algal production of Finnish lakes, and the effects of primary BOD loading are only local. Sediments of polluted lakes are a source of internal loading which tends to maintain eutrophication, even after reduction of the wastewater load. Lake bottom sediment plays a key role in the sense that the upper 30 cm layer of the bottom sediment contains 50-500 times more soluble phosphorus than the water above it. Polluted lake sediment must be removed, isolated or conditioned to retain phosphorus. The oxygenation of hypolimnion and, through it, bottom sediment, is a cornerstone in lake management. The initial phase of oxygenation may consume great volumes of oxygen. Techniques to be used are sediment oxygenation with nitrates, and a transfer of oxygen to the near-bottom layers by destratification or hypolimnetic oxygenation. (Moore-IVI)
W85-02387

NITRATE LEACHING FROM GRASSLAND,
Grasslands Research Inst., Hurley (England).
J. C. Ryden, P. R. Ball, and E. A. Garwood.
Nature, Vol. 311, No. 5981, p 50-53, September, 1984. 1 Fig, 3 Tab, 27 Ref.

Descriptors: *Nitrates, *Grasslands, *Leaching, *England, Animal wastes, Grazing, Pastures, Water pollution sources, Fertilizers.

Increased awareness of the economic importance of losses of nitrogen from agricultural land, together with the recognition that nitrate in drinking water is potentially detrimental to human health, have stimulated research on nitrate leaching. Substantial amounts of nitrate can be leached from intensively farmed grassland as well as when grassland is ploughed in a ley-arable system. The most striking feature is the effect of ruminant production on nitrate leaching. The annual loss of nitrate from a grazed grass sward was 5.6 times greater than that below the comparable cut sward, despite a common input of fertilizer N and defoliation frequency. The enhanced nitrate movement below the grazed sward can be attributed mainly to the return in urine and dung of as much as 90% of the N in the herbage consumed by cattle. At the end of the grazing season in October 1982, the mean nitrate content of soil below urine- and dung-affected areas of pasture was 3.2 to 7.7 times greater than that observed during random sampling across the grazed sward. Additional inorganic N was present as NH4(+), much of which had been nitrified by the time the profile was sampled in December at the onset of the drainage season. The small amount of residual inorganic N below the cut sward reflected the removal of at least 75% of the applied N in the harvested herbage. The cutting and conservation of herbage, and its subsequent use as feed, merely serves to delay the loss of nitrate that can occur after the disposal of slurry and farm-yard manure from winter-housed cattle. (Baker-IVI)
W85-02404

BEHAVIOUR OF PHOSPHATE, NITRATE, CHLORIDE AND HARDNESS IN TWELVE WELSH RIVERS,
Welsh Water Authority, Powys (Wales).
M. P. Brooker, and P. C. Johnson.
Water Research, Vol. 18, No. 9, p 1155-1164, 1984. 6 Fig, 6 Tab, 31 Ref.

Descriptors: *Water quality, *Land use, *Rivers, *Wales, Phosphates, Nitrates, Hardness, Chloride, Domestic wastes, Agricultural chemicals, Runoff, Flow, Urban runoff, Geology.

Water quality data from the 12 rivers was sought as part of the Harmonized Monitoring Scheme (HMS) in efforts to increase the information available regarding location, time and flow and improve attempts to estimate mass flows. In particular these determinands were chosen to establish the general variability of behavior in relation to urban settlement (phosphate-P), land use (nitrate-N) and geology (total hardness). Chloride was included as an example of a relatively conservative substance. Mean nitrate-N concentrations varied from 0.4 to 3.7 mg/l and were significantly related to the intensity of average catchment runoff. Mean orthophosphate-P concentrations ranged from the limit of analytical detection to 0.730 mg/l; chloride from 11 to 42 mg/l and total hardness, as calcium carbonate, from 13 to 173 mg/l. No long term seasonal trends could be established. Relationships between concentration and flow were established for most determinands at many sites; increasing flow generally resulted in decreased concentration. Positive relationships were established at 7 sites between nitrate concentration and flow. Mass flows were calculated at nine sites. Orthophosphate flows were related to sewered population density, estimates of per capita and land drainage contributions being 1.9 g/day and 0.112 kg/ha/yr, respectively. (Baker-IVI)
W85-02435

STREAM ECOSYSTEMS IN MOUNTAIN GRASSLAND (WEST CARPATHIANS); 7. CILIATA,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
E. Grabacka.
Acta Hydrobiologica, Vol.24, No. 4, p 367-373, 1982. 1 Fig, 1 Tab, 13 Ref.

Descriptors: *Grasslands, *Protozoa, *Runoff, *Water pollution sources, *West Carpathians, *Poland, Population dynamics, Fertilizers, Land use, Grazing, Streams.

The composition and numbers of communities of Ciliata were investigated in two streams of the upper Grajcarek catchment basin where agricultural wastes are introduced by the groundrunoff from areas where the traditional pastoral system is practiced and from those areas of intensive pasturing. Communities were evaluated on stony bottom and on a slimy bottom of the mountain streams Biala Woda and Kamionka. The current runoff of pollution to the streams did not bring about any significant change in Ciliata communities. The differentiation of these communities depended rather on the variability of the stream bottom. (Baker-IVI)
W85-02518

STREAM ECOSYSTEMS IN MOUNTAIN GRASSLAND (WEST CARPATHIANS); 8. BENTHIC INVERTEBRATES,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
A. Kownacki.
Acta Hydrobiologica, Vol. 24, No. 4, p 375-390, 1982. 5 Fig, 1 Tab, 16 Ref.

Descriptors: *Grassland, *Benthic environment, *Streams, *Land use, *Western Carpathians, *Poland, Midges, Seasonal variations, Floods, Nutrients, Grazing.

The dependence between the intensification of pastoral economy and the communities of benthic invertebrates in streams was investigated. The quantitative and qualitative changes in the fauna in the different habitats at the sampling stations, the percentage structure, and the pattern of seasonal cycles at the stations were analyzed. The influence of sheep grazing was chiefly manifested by the growing percentage of Chironomidae in the whole fauna, changes in the domination structure and disturbances in regular seasonal cycles of benthic invertebrates. In the qualitative composition of the fauna, however, there was little change. The changes in the communities were brought about not only by the increase in content of mineral nutrients in the water but also by the variability of water flow, insulation, and temperature caused by the cutting down of forests and associated with pastoral land use. (Baker-IVI)
W85-02519

SUPERFUNDING ACID RAIN CONTROLS, WHO WILL BEAR THE COSTS,
S. L. Rhodes.
Environment, Vol. 26, No. 6, p 25-32, July-August, 1984. 4 Fig, 38 Ref.

Descriptors: *Acid rain, *Economic aspects, Water pollution control, Legislation, Taxation, Federal jurisdiction, Political aspects.

Acid rain has become a major environmental and political issue in the United States. There have been several legislative proposals to control acid rain in the eastern US. The idea of creating an acid rain superfund to help finance the installation of flue gas desulfurization systems or other technologies to reduce the release of sulfur dioxide and nitrogen oxides by old coal burning electric power plants in the eastern states is proposed. Different variations on the superfund theme can make it more or less politically attractive. Regional conflicts can be intensified or moderated by the features of such a fund. Furthermore, the superfund idea does not appeal to everyone. Some of these liabilities and strengths must be evaluated in the context of both economic and political realities in a presidential election year. Some questions of concern include the raising of the superfund revenue and the technology forcing character of the super-

fund concept as currently discussed, which protects the interests of those associated with high-sulfur coal and discourages them from switching to low-sulfur coal. (Baker-IVI)
W85-02549

INTEGRATING WATER QUALITY AND CONSTRUCTION GRANTS MANAGEMENT,
CH2M/Hill, Reston, VA.
F. W. Ellis, K. S. Klima, R. L. Wycoff, and L. D. McKay.
Journal of the Water Pollution Control Federation, Vol. 56, No. 9, p 1022-1029, September, 1984. 11 Fig, 1 Tab. 5 Ref.

Descriptors: *Water quality control, *Management, Construction, Quality control, COGENT, Computers.

In response to recent legislative and administrative incentives, EPA has developed a new information tool, COGENT, to integrate municipal wastewater treatment management into water quality and water use considerations in the 1984 Needs Survey. COGENT links previously unrelated facility and water quality data by use of the Reach File. It consists of a data base containing information relating to stream systems and characteristics, point source pollution sources, state water quality standards and ambient conditions; a water quality model that simulates dissolved oxygen and ammonia, and a reporting capability that displays the results of the water quality simulations or the contents of the data base in either graphic or tabular form. (Baker-IVI)
W85-02583

REMOVAL AND INACTIVATION OF BACTERIA DURING ALUM TREATMENT OF A LAKE,
Washington State Univ., Pullman. Dept. of Civil and Environmental Engineering.
P. C. Bulson, D. L. Johnstone, H. L. Gibbons, and W. H. Funk.
Applied and Environmental Microbiology, Vol. 48, No. 2, p 425-430, August, 1984. 5 Fig, 1 Tab, 18 Ref. EPA contract R805604-01.

Descriptors: *Alum, *Lake restoration, *Bacteria, Flocculation, Recreational lakes, Eutrophic lakes, Fecal coliforms, Escherichia, Public health, Swimming, Potable water.

Flocculation and removal of bacteria were observed during two separate aluminum sulfate (alum) treatments for removal of phosphorus from a eutrophic recreational lake. In addition, die-off and release of bacteria from alum floc were studied in columns under laboratory conditions. Membrane filtration and spread plates were used to determine concentrations of indicator species and total cultivatable bacteria, respectively. During the alum treatment of the lake, 90% of the fecal coliform (FC) population and ca. 70% of the fecal streptococci population were removed from the water column within 72 h. Numbers of FC in the floc on the lake bottom exceeded 2,400/100 ml at 120 h compared with the pretreatment concentration of 30 FC/100 ml. Inactivation of FC in the floc proceeded at a rate of 200 FC/100 ml per 24 h. In a second alum application to the lake, 95% of the total culturable bacterial population was removed from the water column. In a laboratory column study of survival and release rates, over 90% of an Escherichia coli suspension was concentrated in a floc formed at the bottom. E. coli was not released from the floc. The numbers of and survival of E. coli in the floc suggest the probable concentration of other enteric organisms, including pathogens. Thus, the floc poses a potential human health risk if ingested by swimmers or if others use the lake as a potable water source. (Author's abstract)
W85-02602

AERATION OF ANOXIC HYPOLIMNETIC WATER: EFFECTS ON NITROGEN AND PHOSPHORUS CONCENTRATIONS,
Saskatchewan Univ., Saskatoon. Dept. of Soil Science.
D. J. McQueen, and D. R. S. Lean.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 1, p 268-276, July, 1984. 4 Fig, 53 Ref.

Descriptors: *Nitrogen, *Phosphorus, *Aeration, *Hypolimnion, *Lake St. George, *Ontario, Nutrients, Oxygen, Iron, Thermal stratification.

The concentrations of NH3-N, NO3-N, NO2-N, total Kejdahl N, total soluble P, soluble reactive P, total particulate P, soluble unreactive P and total iron were measured periodically at depths of 1, 3, 5, 8, 12, and 14 m in two large enclosures situated at Lake St. George, Ontario. Each enclosure contained about 550 cu m of water, was 8 m in diameter, and 14 m deep and was open to the mud water interface. One enclosure received hypolimnetic aeration from June 17, 1980 until November 2, 1981, the other was not aerated. Macronutrients were added to both enclosures each week during the summer months. Iron was added to the hypolimnetic waters of both enclosures once during September 1980 and three times during September of 1981. Oxygen levels in the aerated encosure were kept at $>$ 4 mg oxygen/liter. In the control, oxygen levels fell to 0 mg oxygen/liter. Thermal stratification was similar in both enclosures. All of the forms of N that were measured were higher in the aerated hypolimnion. All of the forms of P that were measured were less concentrated in the aerated hypolimnion and iron additions caused further reductions in the aerated enclosure, but had no effect in the anoxic control. Iron concentrations were lower in the aerated hypolimnion. (Baker-IVI)
W85-02626

NUTRIENT REDUCTION BY BIOMANIPULATION: AN UNEXPECTED PHENOMENON AND ITS POSSIBLE CAUSE,
Minnesota Univ., Minneapolis. Limnological Research Center.
D. I. Wright, and J. Shapiro.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 1, p 518-524, July, 1984. 4 Fig, 1 Tab, 30 Ref.

Descriptors: *Zooplankton, *Nutrients, *Biomanipulation, Trophic level, Algal growth, Daphnia, Crustaceans, Phosphorus, Transport, Thermocline, Thermal stratification, Herbivores.

A variety of mechanisms can be hypothesized to explain how changes in the zooplankton community cause nutrient declines. To test an active transport hypothesis, a series of lab experiments was performed using stock cultures of Ankistrodesmus, labelled with P-33 which were fed to D. pulex over a 8 day period. Uniformly labelled D. pulex were then induced to migrate in columns through a 12 C thermocline on a 16:8 hour cycle. The results of the migration experiments indicate that significant quantities of dissolved P were transported across the thermocline into the upper halves of the columns. The rate of transport by excretion remained relatively constant over the 3-day duration of the experiment. Such transport of nutrients can remove nutrients from the water column entirely. If the large-bodied herbivores reach the lake bottom or migrate into macrophyte beds, the excreted nutrients may be actively sorbed by the oxidized sediments and benthic algae, or by macrophytes and their associated periphyton. If true, biomanipulation becomes a two-edged sword - eliminating algae by grazing and by reducing nutrient resources simultaneously. (Baker-IVI)
W85-02645

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

COPA II AND THE RIVER MERSEY - A REGIONAL WATER AUTHORITY VIEW,
North West Water Authority, Warrington (England).
For primary bibliographic entry see Field 5D.
W85-02225

STOCHASTIC OPTIMIZATION MODEL FOR REAL-TIME OPERATION OF RESERVOIRS USING UNCERTAIN FORECASTS,
Washington Univ., Seattle. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4A.
W85-02360

FORECASTING WATER LEVELS FOR LAKE CHAD,
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
K. Guganesharajah, and E. M. Shaw.
Water Resources Research, Vol. 20, No. 8, p 1053-1065, August, 1984. 7 Fig, 7 Tab, 6 Ref.

Descriptors: *Lake Chad, *Lakes, *Water level fluctuations, *Forecasting, River Chari, Mangement planning, Model studies, Selective withdrawal, Markov process.

Since the early part of the last decade, a widespread drought in the semi-arid zone surrounding Lake Chad (Chad, Nigeria, Niger, and Cameroun) has affected the lake levels and runoff from certain contributing catchments in the basin. A model was developed for accurately predicting the low levels in Lake Chad as many as 8 months ahead; it will assist in the planning of the agriculture operations one season in advance for schemes that rely on the lake water. A statistical model for describing the probability of the low-level variations at various periods ahead was also developed and can be used to measure the risk involved in selecting various abstraction levels of water from the lake during the proposed life span of the projects; this is also a particularly useful aid in economic and planning studies for future development. The probabilistic model is based on the Markov chain process applied to two statistical models of the main input variable (the runoff from the River Chari); the first assumes the annual discharge to be random and the second incorporates significant cyclical components, although determined from inadequate data, and a large stochastic component. The error component leads to some error in the state transition matrices which can be neglected due to the high value of coefficient of determination of the model and the generous discrete interval of 0.5 m chosen in representing the lake states. (Collier-IVI)
W85-02362

SHORT-TERM, SINGLE, MULTIPLE-PURPOSE RESERVOIR OPERATION: IMPORTANCE OF LOSS FUNCTIONS AND FORECAST ERRORS,
Washington Univ., Seattle. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4A.
W85-02658

MONTE CARLO OPTIMIZATION FOR RESERVOIR OPERATION,
Humboldt State Univ., Arcata, CA. Dept. of Environmental Resources Engineering.
For primary bibliographic entry see Field 4A.
W85-02659

6B. Evaluation Process

DETERMINATION OF ECONOMICALLY FEASIBLE PARAMETERS OF CONDUITS OF HYDROELECTRIC STATIONS,
V. M. Adamov.
Hydrotechnical Construction, Vol. 17, p 657-663, December, 1983. 3 Tab, 7 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 12, p 45-49, December, 1983.

Descriptors: *Economic aspects, *Conduits, *Hydroelectric plants, *Feasibility studies, Tunnels, Powerplants.

Economically expedient dimension of tunnels and pipelines are most simply calculated by formulas. Such formulas are available only for circular water conduits; analytical calculation methods have still not been developed for free-flow tunnels and

canals. Insufficient attention is being devoted also to schemes of hydraulic connections in layout designs for which it is required to use special calculation methods. The design of conduits is substantially hindered in connection with the absence of sufficiently founded formulas for approximate calculation of their cross sections. Calculations are proposed to help solve some of these problems. The optimal cross sections of tunnels (pressure and free-flow) and of steel conduits should be determined by means of exact equations for detailed design stages and by approximate equations for rough calculations. In the case of complex layout schemes with the presence of daily storage reservoirs it is not possible to use analytical methods of calculating the cross sections of tunnels and conduits. The possibilities of using equations for calculating optimal cross sections of canals and flumes of hydroelectric stations are extremely limited. It is necessary to develop methods of optimizing power conduits, including both analytical and ordinary power-economic methods of their calculation. (Baker-IVI)
W85-02233

HYDROELECTRIC GENERATOR USED BY TREATMENT PLANT,
North Andover, MA.
For primary bibliographic entry see Field 5D.
W85-02301

ECONOMIC EFFECTS OF RIVER CONSTRUCTION WORKS,
National Board of Waters, Helsinki (Finland).
L. Kattelus, and O. Niemi.
Aqua Fennica, Vol. 13, p 34-43, 1983. 3 Fig, 1 Tab, 1 Ref.

Descriptors: *Economic evaluation, *Flood protection, *Construction costs, *Lapuanjoki, *Finland, Cost-benefit analysis, Hydroelectric plants, Rivers, Drainage.

The economic profitability of the river construction works and their importance to the communes of the river basin have been studied using the Lapuanjoki watercourse as a case study. The impetus of the Lapuanjoki river construction works in 1959 - 1978 was flood protection for agriculture. The investments required an input of nearly 200 million FIM. The construction works created conditions for complementary investments, namely Hirvikoski powerplant, underground ditching and forestry drainage. The study was mainly carried out by the National Board of Waters together with Tampere University of Technology. The essential methods applied in the study were input-output analysis, profitability analysis, allocation analysis and cumulative effect of consumption analysis. Without the complementary investments the output-input ratio was 0.78, and the project was not economically profitable. The computing interest in analyses was 4% up to 1981 and from 1981 to 2010, 3%. Hirvikoski powerplant made the project expedient from the national point of view (output-input ratio 1.27). Other complementary investments improved the output-input ratio. The input-output analysis showed that the works were profitable from the regional point of view. This was because the government paid for the river construction works and the income during the construction and the outputs after the construction remained for the most part in the region. The allocation analysis revealed that a third of the assets returned to the state as taxes and social security payments. A great part of the construction cost remained as salaries in the region and the profits of the construction works remain in the region. (Author's abstract)
W85-02392

ACCOUNTABILITY MANAGEMENT BRINGS REVENUE INCREASES,
Springfield City Water, Light and Power, IL.
R. J. Orr.
Water Engineering and Management, Vol. 131, No. 9, p 22-26, August, 1984. 5 Tab.

Descriptors: *Decision making, *Water loss, *Water distribution, Management, Testing, Evaluation.

City Water, Light and Power which serves Springfield, Illinois, has an average daily metered output to the distribution system of 20 mil gal. At various times during past years, unaccounted for water was as high as 25%. The program to find the problem was divided into four steps. The first phase consisted of testing high service water source meters at the purification plant to determine the actual quantity of water pumped to the distribution system. Phase two called for testing of 3 inch and larger meters. Phase three called for testing, repair and/or recalibration of 1-2 inch meters. Phase four of the loss reduction program targeted residential meters. By implementing corrections in each of these four phases, much revenue was saved and service was significantly improved. (Baker-IVI)
W85-02486

CONCURRENT DEVELOPMENT OF AN INDUSTRIAL WASTE PRETREATMENT PROGRAM AND RESIDUAL SOLIDS MANAGEMENT PLAN,
CH2M/Hill, Denver, CO.
For primary bibliographic entry see Field 5D.
W85-02572

PUMPED-STORAGE: PEAK GENERATION OR OPERATING RESERVE,
For primary bibliographic entry see Field 8A.
W85-02673

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

COST SHARING WITH IRRIGATED AGRICULTURE: PROMISE VERSUS PERFORMANCE,
Wyoming Univ., Laramie. Dept. of Agricultural Economics.
D. R. Franklin, and R. K. Hageman.
Water Resources Research, Vol. 20, No. 8, p 1047-1051, August, 1984. 6 Tab, 9 Ref.

Descriptors: *Cost sharing, *Irrigation, *Cost analysis, Capital costs, Operating costs, Maintenance costs, Replacement costs, Upper Colorado River Basin, Upper Missouri River Basin, Pick-Sloan Missouri River Basin Program, Accounting procedures, Water projects.

Since the Reclamation Project Act of 1939, irrigated agriculture has been assigned responsibility for privately funding a portion of the capital costs, and 100% of the allocated operations/maintenance costs, for federal water projects. Actual cost share payments from agriculture have contributed relatively little to project funds. The extent of the deviation between projected private user cost sharing and actual payments collected was determined by analysis of financial data from various federal water projects. Irrigated agriculture is heavily subsidized, not only with respect to capital expenditures, but also for operation, maintenance, and replacement (OM and R) costs. Financial data was compiled for 19 projects implemented beginning in the late 1940's on the Upper Colorado River Basin and on the Upper Missouri River Basin. Irrigation is allocated 73.2% of total capital costs but is ultimately expected to repay 3.8% of capital costs allocated to irrigated agriculture. This indicates that the capital cost subsidy to irrigated agriculture is in excess of 96%. Of this, financial records indicate that over 78% of the repayment of cost is made by power revenues in the two Basin Funds. Data from the Pick-Sloan Missouri River Basin Program, 1979 financial statement provide support for the observation that the structure of OM and R repayments by agricultural users is altered by strategic shifting of accounts; of $853,000 in OM and R costs for nonelectric uses, only 4% was allocated to agricultural users, whereas 64% was allocated to nonreimbursable features. Enforcement of current guidelines for requiring private funding to a portion of capital costs and all of proportionate OM and R costs would be facilitated with the establishment of standardized and systematic financial accounting guidelines; this is especially true with respect to allocating water use by irrigated agriculture among reimbursable and nonreimbursable categories. (Collier-IVI)
W85-02361

COST ESTIMATES FOR HYDROPOWER AT EXISTING DAMS,
Minnesota Univ., Minneapolis. Dept. of Civil and Mining Engineering.
J. S. Gulliver, and A. Dotan.
Journal of Energy Engineering, Vol. 110, No. 3, p 204-214, September, 1984. 5 Fig, 1 Tab, 10 Ref.

Descriptors: *Cost analysis, *Hydroelectric plants, Construction costs, Estimating, Costs, Evaluation, Hydraulic equipment.

Guidelines are developed for quick and simple hydropower project cost estimating in the preliminary site assessment stage. A concept which incorporates a single equation using design power and head for total equipment cost and a site factor to determine total project cost forms the basis of this approach. Total cost for the project is estimated by multiplying the equipment cost and the site factor. Total project cost data from a number of hydropower projects are compiled to provide guidelines for choosing the site factor which can vary greatly, especially for micro and mini hydropower projects. Envelope curves for site factors are given and a weighting factor which is the fraction distance between upper and lower envelope curves is chosen for each site. Comparison with recently completed projects, a knowledge of the components which can greatly increase civil works costs, and engineering judgement are combined to make the choice of weighting factor. This factor is then used in calculations to determine optimum plant capacity. The method was used in a survey of the hydropower potential at existing Minnesota Dams. (Baker-IVI)
W85-02442

6D. Water Demand

VIRGINIA'S WATER LAW: RESOLVING THE INTERJURISDICTIONAL TRANSFER ISSUE,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
W. E. Cox, and L. A. Shabman.
Virginia Journal of Natural Resources Law, Vol. 3, No. 2, p 181-234, Winter, 1984. 1 Fig. 190 Ref.

Descriptors: *Water supply, *Water demand, *Water tranfer, *Legal aspects, Legislation, Virginia, Common law, Water allocation.

Recent water shortages in urban areas of southeastern Virginia have led to the development of controversial water transfer proposals which reveal the potential for competition among local governments in the state over water supplies. The present water allocation system consists of the common law system developed in the early history of the Commonwealth, as supplemented by several relatively independent regulatory measures affecting water use. The creation of a specialized administrative mechanism to resolve conflicts over interjurisdictional water transfers for public water systems is proposed as the most appropriate and economically efficient modification of the present system. Water use is explored in the commonwealth and the need for interjurisdictional water transfers is examined. The current water allocation is outlined and its ability to resolve conflicts associated with interjurisdictional water transfers is analyzed. The implementation and operation of the proposed administrative allocation mechanism is examined. The legal impediments to the adoption of such an administative allocation mechanism are scrutinized. (Baker-IVI)
W85-02183

FLOW REQUIREMENTS FOR RECREATION AND WILDLIFE IN NEW ZEALAND RIVERS - A REVIEW,
Ministry of Works and Development, Christchurch (New Zealand).
M. P. Mosley.
Journal of Hydrology, Vol. 22, No. 2, p 152-174, 1983. 4 Fig, 4 Tab, 55 Ref.

Descriptors: *Water quality control, *Recreation demand, *Recreation wastes, *Water use, *New Zealand, Wildlife, Reviews, Instream flow.

Increasing pressure is being placed on development in areas surrounding New Zealand rivers. As this pressure grows there is an increasing concern that non-developmental uses, with particular attention given to recreation, providing fish and wildlife habitat and enhancement of scenic beauty, be safeguarded. This review covers factors which are associated with these uses and considers their relationship with discharge. Factors which determine the character of a river are grouped into the following categories: landscape setting, floodplain setting, channel character, water character, and scenic quality and recreational potential. Application of the incremental method of flow analysis is described, even though vigorous adherence to the method is presently limited by lack of full information on the flow needs of each instream use. Still, it provides the best framework for assessing instream flow requirements. The Montana method, which is the other commonly used method, has severe limitations and should be restricted to reconnaissance level planning. (Baker-IVI)
W85-02558

6E. Water Law and Institutions

PROBLEMS IN POLLUTION RESPONSE LIABILITY UNDER FEDERAL LAW: FWPCA SECTION 311 AND THE SUPERFUND,
J. C. Helfrich.
Journal of Maritime Law and Commerce, Vol. 13, No. 4, p 455-479, July-October, 1982. 104 Ref.

Descriptors: *Water pollution control, *Legislation, *Superfund, *Federal Water Pollution Control Act, History, Regulations, Evaluation, Enforcement.

A discussion is offered of the history of the Federal Water Pollution Control Act followed by an analysis of the effectiveness of the enforcement arm of the Act, called Section 311. Strengths and weaknesses of the federal government's first major attempt to protect the nation's water environment from vessel and facility pollution are pointed out. The purpose, functions, and regulations of the Superfund are described both as it stands alone and in relation to the FWPCA. While much of the superfund is based upon the FWPCA, most of its elements respond to a specific problem found to be inadequately handled by the FWPCA provisions concerning hazardous substances. The implementing regulations are examined in relation to those previously used for FWPCA operation and enforcement. Many of the shortcomings experienced with the FWPCA have been removed from the scene in the Superfund program. Significant in this respect are increased liabilities; definition expansion of terms; incentives for the responsible parties to conduct their own cleanup; direct action access against insurors; and, the specific non-exclusive nature of the Superfund remedy. A couple of the old problems still exist, however, including the continuing third party confusion in measuring liability and the failure of the new Act to recognize the shortcoming of the FWPCA in not expressly addressing the statute of limitations question. (Baker-IVI)
W85-02172

STATE ENGINEER'S AUTHORITY WITH REFERENCE TO CHANGE OF USE, PLACE OF USE, POINT OF DIVERSION, AND MEANS OF CONVEYANCE OF WATER EMBRACED BY WATER PERMITS,
P. J. Crank.
Land and Water Law Review, Vol. 19, No. 1, p 59-70, 1984. 81 Ref.

Descriptors: *Water permits, *Water demand, *Legislation, *Wyoming, *Green River, Water use, Green River Development Company, Water rights.

The Green River Case is sub-divided into two sections for discussion: the portion of the case dealing with the State Engineer's authority to amend water permits; and the portion of the case dealing with the nature of water permits and their transferability in Wyoming. The Wyoming Supreme Court held that the State Engineer had no authority to change the permit; water permits were not transferable in Wyoming; and all corrections must be within the original intention of the permit. A decision which allowed the State Engineer to transfer a water permit for water which never was beneficially applied would have wreaked havoc on the system and given rise to all manner of speculative ventures for which no substantial or honest investment was intended. (Baker-IVI)
W85-02173

LIMITS OF FEDERAL RESERVED WATER RIGHTS IN NATIONAL FORESTS,
S. D. Emery.
Land and Water Law Review, Vol. 19, No. 1, 1984. 110 Ref.

Descriptors: *Water rights, *National forests, *Colorado, Federal jurisdiction, Reserved rights, Legislation, Instream flows.

On appeal, the Colorado Supreme Court considered the extent to which the federal government possessed reserved water rights on its forest reservations. The United States claimed that its reserved water rights included instream flows, while Denver argued that federal reserved rights did not exist at all. How and why the Colorado Supreme Court restricted the federal government's reserved water rights is examined. Federal reserved rights were limited by the Court to the minimum amount of water necessary to fulfill the primary purposes of national forests. It is viewed as unfortunate that this decision was made which might be the beginning of a trend toward narrow construction of the reserved rights doctrine. The United States is expected to make appeal on the grounds that the federal government had instream flow rights before 1960 for fire protection and erosion control, and after 1960 for wildlife, fish and recreation purposes. (Baker-IVI)
W85-02174

IMPAIRMENT OF EXISTING WATER RIGHTS UNDER THE WYOMING WATERSHED ACT,
C. W. Hansen.
Land and Water Law Review, Vol. 19, No. 1, p 83-92, 1984. 102 Ref.

Descriptors: *Legislation, *Reservoirs, *Water rights, *Wyoming, *Condemnation, Toltec Watershed Improvement District, Reserved rights.

The Toltec Watershed Improvement District (Toltec) was organized in January 1968 to construct a multi-purpose reservoir near Garrett, Wyoming. In 1970 Associated Enterprises, Inc. began a series of actions against Toltec to prevent the condemnation of its land and water rights for the proposed reservoir site. The District court of Albany County granted condemnation for the construction of the reservoir and determined just compensation for the land taken. The Wyoming Supreme Court decided in favor of the condemnation, despite a statutory provision purportedly barring any impairment of such rights. The trend in Wyoming from a predominantly ranching and agricultural area to a more industrial state with an increasing population is underlined by this decision toward optimum use and allocation of water resources. The Court's rejection of the no-impairment provision represents a marked departure from the Wyoming rule that water rights cannot be detached from the land, place or purpose from which they were first acquired. Farmers and ranchers can no longer depend upon this no change rule to protect their water rights, appropriations and priorities. (Baker-IVI)
W85-02175

STATUTORY FORFEITURE OF WATER RIGHTS IN WYOMING,
K. J. Kapp.
Land and Water Law Review, Vol. 19, No. 1, p 93-104, 1984. 88 Ref.

Descriptors: *Water rights, *Forfeiture, *Wyoming, Dam stability, Beneficial use.

In April of 1972 the Wyoming State Engineer reduced the amount of water which could be stored in a local reservoir due to weaknesses in the dam. During the time it took for the dam to be repaired, 8 years, Wheatland Irrigation District filed a forfeiture petition with the Board of Control. The forfeiture declared that the Laramie Rivers Company had forfeited its rights to 41,400 acre feet of water, the difference between the 68,500 usually held in the reservoir and the restriction of 27,400 acre feet imposed by the State Engineer. While a lower court upheld the dam reconstruction and rejected the forfeiture filed by the Laramie Rivers Company, the Supreme Court of Wyoming reversed the lower court's decision. This established the rule that forfeiture of water rights under section 41-3-401 of the Wyoming Statutes may only be avoided by application of the water to beneficial use. Thus, undertaking efforts to repair a dam in order to put a reservoir back into use will not prevent forfeiture, even if such efforts are commenced before a forfeiture petition is filed. (Baker-IVI)
W85-02176

UNITED STATES V. OSWEGO BARGE CORPORATION,
Goldstein (Seymour R.), Baltimore, MD.
A. S. Lyons.
Ocean Development and International Law, Vol. 14, No. 1, p 107-117, 1984. 51 Ref.

Descriptors: *Oil spills, *Legal aspects, *Cleanup operations, Legislation, Federal Water Pollution Control Act, Water pollution control.

The holding and analysis used by the court in United States v. Oswego Barge Corporation are discussed and it is concluded that the government's source of compensation is limited to the frequently inadequate provisions of the Federal Water Pollution Control Act. When the applicable FWPCA limits exceed government cleanup costs, the statutory scheme works well. But the FWPCA does not always adequately compensate the federal government. The FWPCA will prove insufficient to finance removal of a spill from a relatively small vesssel or barge, as well as when a large vessel spills a great deal of oil. Therefore the federal government may be forced to require the states to assume greater responsibility for oil spill cleanup. If the federal government may avail itself of the remedies the federal common law of nuisance and maritime tort afford, the alternate route of encouraging state cleanup becomes less attractive. A regulatory scheme that emphasizes the federal role and relies on federal law would be more consistent with the general admiralty purpose of assuring uniform adjudication of maritime law claims. (Baker-IVI)
W85-02177

MIDDLESEX COUNTY SEWERAGE AUTHORITY V. NATIONAL SEA CLAMMERS ASSOCIATION,
C. M. Smith.
Ecology Law Quarterly, Vol. 10, No. 1, p 39-50, 1982. 97 Ref.

Descriptors: *Legislation, *Enforcement, *Water pollution effects, *Fishing, Federal Water Pollution Control Act, National Sea Clammers Association, New York, Harbors.

One concern in this case was whether a private group of fishermen could recover damages under federal law for business injuries allegedly caused by pollution of New York Harbor and adjacent waters. The New Jersey District Court granted summary judgment for defendants on all counts of the complaint, and the judge dismissed with prejudice all claims arising under federal law. The court refused to hear the claims arising under FWPCA and MPRSA because plaintiffs had failed to comply with the 60 day notice requirement of the private enforcement provisions of the acts. The court also rejected plaintiffs' nuisance claim on the ground that a private cause of action is not avail-

able under the federal common law of nuisance. The Court of Appeals for the Third Circuit reversed the district court on each of these issues. The Supreme Court limited its review to three questions: whether private rights of action apart from those provided in the citizen-suit provisions may be implied in FWPCA and MPRSA; whether FWPCA and MPRSA preempt the federal common law of nuisance in the area of ocean pollution; and if there is no preemption, whether a private citizen has standing to sue for damages under federal common law of nuisance. The Supreme Court rules against plaintiffs on all the federal claims it had granted certiorari to review and remanded the case to the Circuit Court for further consideration. The Sea Clammers Court casts doubt on the integrity of its process of statutory construction by a questionable construction of the language and legislative history of the Acts. In light of its continuing reluctance to imply private rights of action in federal statutes and its apparent goal of restricting the availability of the section 1983 remedy, it is evident that the Sea Clammers Court forced a ruling of anti-private rights doctrine through an opening of statutory construction. (Baker-IVI)
W85-02178

CITY OF MILWAUKEE V. ILLINOIS (ILLINOIS II),
J. Derr.
Ecology Law Quarterly, Vol. 10, No. 1, p 51-68, 1982. 155 Ref.

Descriptors: *Legislation, *Nuisance, *Water pollution control, *Milwaukee, *Illinois, Legal aspects, Common Law.

The Court in Illinois II appears to apply a blanket preemption of the federal common law of nuisance. The decision need not be that broad. Separation of powers would be maintained, and the supremacy of Congress recognized, even if the Court required clear Congressional intent to preempt the federal common law. The Act authorized relief of the same type granted by the lower court in Illinois II - effluent standards and timetables for overflow control. The federal common law, however, did not speak primarily to the type of relief it was to provide. Rather, it spoke to the avoidance of state law remedies in order to protect state and federal interests in uniform and fair resolution of interstate disputes. The Act does not speak to protection of these interests. Even if the bulk of the statute did speak directly to the questions formerly governed by federal common law, the savings clauses appear to preserve the common law remedy. The majority's strained reading of the savings clauses, and its uncritical application of a preemption test, have needlessly recreated the very problems that originally justified the federal common law of nuisance. (Baker-IVI)
W85-02179

EPA V. NATIONAL CRUSHED STONE ASSOCIATION,
A. Ranken.
Ecology Law Quarterly, Vol. 10, No. 1, p 161-180, 1982. 162 Ref.

Descriptors: *Water pollution control, *Industrial waste, *Legislation, Federal Water Pollution Control Act, National Crushed Stone, Environmental Protection Agency.

The Supreme Court's decision in National Crushed Stone is considered against a background of the relevant portions of the Federal Water Pollution Control Act and the appellate court's holdings. The weaknesses in the apellate court's decision invalidating EPA's variance provision is examined and an alternative argument for invalidation tendered by the industries challenging the provision is evaluated. An examination is offered of the potential impact of the National Crushed Stone decision on future water pollution control efforts, as well as with some observations on the role of the judiciary when reviewing agency interpretation of a statute it administers. (Baker-IVI)
W85-02180

RECOVERY OF DAMAGES BY STATES FOR FISH AND WILDLIFE LOSSES CAUSED BY POLLUTION,
For primary bibliographic entry see Field 5C.
W85-02181

PROTECTING THE PEOPLE'S WATERS: THE CALIFORNIA SUPREME COURT RECOGNIZES TWO REMEDIES TO SAFEGUARD PUBLIC TRUST INTERESTS IN WATER,
K. M. Raymond.
Washington Law Review, Vol. 59, No. 2, p 357-373, April, 1984. 90 Ref.

Descriptors: *Water supply development, *Public trust doctrine, *Legal aspects, *California, *Mono Lake, Water rights, Legislation, Appropriation, Water allocation.

Public trust remedies presently in place in California are outlined by discussing the background of the public trust doctrine and the appropriative water rights system in California as well as the holdings of the Mono Lake court. A change is proposed to improve both the administrative and judicial public trust remedies. In Mono Lake the California Supreme Court addressed two issues critical to the protection of public trust interests in state water allocation decisions. The first was whether the public trust doctrine was subsumed within the appropriative water rights system. The second was whether plaintiffs seeking to enforce the public trust were required to exhaust administrative remedies before filing suit. Mono Lake mandates consideration of the public trust in all water rights decisions. To ensure that the public trust is taken into account when required, the Mono Lake court recognized both an administrative and a judicial remedy. Important public trust interests in water resources may not be adequately protected unless the remedies designed to protect them are strong. Recommended changes to the administrative and judicial remedies recommended would help to ensure that the mandates of Mono Lake are realized. (Baker-IVI)
W85-02182

VIRGINIA'S WATER LAW: RESOLVING THE INTERJURISDICTIONAL TRANSFER ISSUE,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6D.
W85-02183

GROUNDWATER AND INTERGOVERNMENTAL RELATIONS IN THE SOUTHERN SAN JOAQUIN VALLEY OF CALIFORNIA: WHAT ARE ALL THESE COOKS DOING TO THE BROTH,
For primary bibliographic entry see Field 4B.
W85-02184

HISTORY OF THE ATTEMPTED FEDERAL REGULATION REQUIRING GAC ADSORPTION FOR WATER TREATMENT,
Houston Univ., TX. Dept. of Civil Engineering.
J. M. Symons.
Journal of the American Water Works Association, Vol. 76, No. 8, p 34-43, August, 1984. 3 Fig, 2 Tab, 49 Ref.

Descriptors: *Activated carbon, *Water treatment, *Organic compounds, Legislation, Federal jurisdiction, Environmental Protection Agency, History, Trihalomethanes, Drinking water.

Attempts made by the federal government to require certain water systems to use granular activated carbon (GAC) adsorption treatment for the removal of synthetic organic contaminants are traced. The Safe Drinking Water Act has two main features which are important to the history of the control of organics in drinking water: the intent of Congress to control organics in drinking water by passing the Act; and the Act gave EPA the option to specify the treatment technique that designated water utilities must use. In February of 1978 the EPA proposed a two part regulation for the control of organic contaminants in drinking water, part of which proposed the use of GAC adsorption as a treatment technique. In November of 1979 the EPA issued a regulation for the control of trihalomethanes in drinking water. In March-April of 1981 the EPA held a symposium on the treatment of water with GAC. During the fall of 1982 bills were introduced to congress that would have changed the language of the Safe Drinking Water Act and would have eliminated the option of specifying a treatment technique as one method of regulating water quality. During 1982 the American Water Works Service Company permanently removed spent GAC from five of its systems due to the presence of GAC in the filters which seemed to be aggravating an intermittent problem of positive coliform samples. In January of 1983 the council of Cincinnati, Ohio voted to authorize the design of an upgraded water treatment plant using GAC adsorption in the postfiltration mode. (Baker-IVI)
W85-02399

MUNICIPAL COMPLIANCE - ANOTHER VIEW,
Illinois State Environmental Protection Agency, Springfield. Div. of Water Pollution Control.
D. J. Schaeffer, H. W. Kerster, and K. G. Janardan.
Journal of the Water Pollution Control Federation, Vol. 56, No. 8, p 924-917, August, 1984. 4 Tab, 6 Ref.

Descriptors: *Water pollution control, *Compliance, *Municipal wastewater, Water quality control, Industrial wastes, Effluents, Statistical studies.

General Accounting Office (GAO) studied the noncompliance rates of a random sample of 631 major dischargers - 274 municipal and 257 industrial - in six states. The data in the GAO report is reanalyzed and the statistical basis for evaluating compliance is examined. The important conclusion is that EPA noncompliance rates are consistent with GAO rates. The distribution of noncompliance results from a mixing process, and estimating the rate of noncompliance entails some explicit and implicit assumptions. One factor affecting the size of GAO's significant noncompliance rates is definitional, the other is statistical. The definitional problem is that GAO included fecal coliform and flow, pollutants likely to have high noncompliance rates. The statistical problems are complex and are summarized. (Baker-IVI)
W85-02571

INTEGRATING WATER QUALITY AND CONSTRUCTION GRANTS MANAGEMENT,
CH2M/Hill, Reston, VA.
For primary bibliographic entry see Field 5G.
W85-02583

6F. Nonstructural Alternatives

TWO-DIMENSIONAL FLOOD ROUTING ON STEEP SLOPES,
Post, Buckley, Schuh and Jernigan, Inc., Tampa, FL.
R. A. Laura, and J. D. Wang.
Journal of Hydraulic Engineering, Vol. 110, No. 8, p 1121-1135, August, 1984. 6 Fig, 3 Tab, 13 Ref. FEMA contract H-4734.

Descriptors: *Flood routing, *Model studies, *Rio Culebrinas Basin, *Puerto Rico, ROUTWEIR, Computer models.

The Rio Culebrinas Basin in Puerto Rico was studied in detail with the two-dimensional ROUTWEIR model, as part of a federal flood insurance study approved by FEMA (Federal Emergency Management Agency) The study included a calibration against known high-water marks from a 5-yr flood. This was achieved mainly by adjusting the conveyance coefficient. The application of the model, with its parameters calibrated using one set of data, has produced reasonable results over a large range of flow. The formulation of flow from element to element allows the model to have a moving boundary. Dry elements can be

allowed to flood and flooded elements can be allowed to dry up. Elements can also be partially filled with water. This approach combined with the flexible schematization afforded by the triangular elements enables the program to handle a highly variable topography with relative ease. The model is expected to perform equally well in other areas with relatively peaked hydrographs, steep slopes, and extensive flood plains. The run time is in general a function of time step size, hydrograph duration, and the number of elements. The described model, ROUTWEIR, has been successfully applied in a federally funded flood insurance study. (Baker-IVI)
W85-02267

6G. Ecologic Impact Of Water Development

IMPAIRMENT OF EXISTING WATER RIGHTS UNDER THE WYOMING WATERSHED ACT,
For primary bibliographic entry see Field 6E.
W85-02175

PROTECTING THE PEOPLE'S WATERS: THE CALIFORNIA SUPREME COURT RECOGNIZES TWO REMEDIES TO SAFEGUARD PUBLIC TRUST INTERESTS IN WATER,
For primary bibliographic entry see Field 6E.
W85-02182

SESTON MICROBIAL ACTIVITY IN A RIVER-RESERVOIR SYSTEM,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
For primary bibliographic entry see Field 2H.
W85-02249

MINERAL CONCENTRATION WITHIN FRESHWATER MARSH PLANT COMMUNITIES,
Florida Univ., Gainesville. School of Forest Resources and Conservation.
W. S. Terry, and G. W. Tanner.
Journal of Freshwater Ecology, Vol. 2, No. 5, p 509-518, August, 1984. 5 Fig, 1 Tab, 12 Ref.

Descriptors: *Minerals, *Marshes, *Florida, *Vegetation, Calcium, Iron, Potassium, Magnesium, Manganese, Nitrogen, Phosphorus, Seasonal variation, Flood control, Environmental effects, Land use.

Freshwater marshes have often been drained or channelized in Florida for tame pasture conversion, flood control or urban development. This has exacerbated water quality problems. Three freshwater marshes in south Florida were studied. Each was a watershed possessing varying degrees of agricultural development: rangeland, tame pasture and one watershed with a combination of rangeland, tame pasture and groveland. Samples were analyzed for concentrations of Ca, Fe, K, Mg, Mn, N and P. Mineral concentrations in the macrophytes growing in these marshes reflected the agricultural activities found in their respective watersheds. Higher concentrations of nutrients were found in vegetation growing in watersheds with tame pastures and citrus groves than in the rangeland watershed, except for Fe concentrations. At each marsh site, mineral concentrations in the vegetation tended to increase with an increased degree of inundation. This response probably was due to increased nutrient loading from runoff water and stored nutrients in the inundated soils. Little seasonal fluctuation of mineral concentrations in the green vegetation samples was noted with the exception of potassium concentrations. Not only did vegetation in the marsh communities generally have the highest mineral concentrations on a per gram basis, total mineral accumulation within the marsh community would be greater due to the higher amounts of standing phytomass. (Baker-IVI)
W85-02250

DETERMINATION OF OPTIMUM MINIMUM FLOW FROM A DAM BY USING ENERGY ANALYSIS,
South Carolina Univ., Columbia. Dept. of Environmental Health Sciences.
For primary bibliographic entry see Field 4A.
W85-02297

ATTEMPTS TO ALLEVIATE FISH LOSSES FROM ALLEGHENY RESERVOIR, PENNSYLVANIA AND NEW YORK, USING ACOUSTICS,
Corps of Engineers, Pittsburgh, PA. Pittsburgh District.
For primary bibliographic entry see Field 5G.
W85-02373

EFFECTS OF WATER LEVEL MANIPULATION ON ABUNDANCE, MORTALITY, AND GROWTH OF YOUNG-OF-YEAR LARGEMOUTH BASS IN WEST POINT RESERVOIR, ALABAMA-GEORGIA,
Alabama Cooperative Fishery Research Unit, Auburn.
L. E. Miranda, W. L. Shelton, and T. D. Bryce.
North American Journal of Fisheries Management, Vol. 4, No. 3, p 314-320, 1984. 3 Fig, 3 Tab, 22 Ref.

Descriptors: *West Point Reservoir, *Alabama, *Georgia, *Bass, *Fish management, *Water level, Reservoir operations, Fish populations, Fisheries, Water level.

Water level manipulation was examined as a potential management technique for increasing recruitment of largemouth bass (Micropterus salmoides) in a reservoir where prey availability and utilization were major factors influencing the largemouth bass population. Raising the water level above normal summer pool inundated terrestrial vegetation and provided cover for young-of-year (YOY) largemouth bass. A positive relationship was observed between early survival of YOY largemouth bass and water level during the spawning period. In the post-spawning period, survival rate and abundance of YOY were related directly to water level, but growth was inversely affected. Average standing stock of YOY largemouth bass in August was similar during the 5 years of study, indicating the system supports a particular biomass, and growth decreased when greater number of young were added through enhanced survival. Results of this study suggest that, unless carrying capacity and food availability for YOY largemouth bass are increased concurrently with water level, use of this technique may not result in a strong year class. (Author's abstract)
W85-02375

STUDY AND DEVELOPMENTAL PROJECT FOR LESSENING THE DRAWBACKS OF RIVER CONSTRUCTION WORKS IN FINLAND,
National Board of Waters, Helsinki (Finland).
H. Laikari.
Aqua Fennica, Vol. 12, p 17-25, 1982. 4 Fig, 10 Ref.

Descriptors: *Finland, *Water resources development, *Rivers, *Construction, *Environmental effects, Fisheries, Acidity, Sulfides, Mercury, Peat, Economic aspects, Hydroelectric power, Ice dams.

River construction works in Ostrobothnia (Finland) have been subject to some criticism, which led the National Board of Waters to institute a special project to study and propose measures to diminish the adverse effects of these works. The project consists of 11 separate subprojects: the impacts of the construction works on the fisheries in the River Kyronjoki and its estuary; acidity due to sulfide soils; the accumulation of mercury in fish, especially in artificial lakes; the economic profitability of the river construction works and their importance to the communes of the river basin; means and costs of eliminating floating peat in artificial lakes; increasing the oxygen content of river water at overflow weirs and power stations; flood forecasts; the formation of ice dams and the possibility of prevention; the adjustment of hydraulic structures to the landscapes; the adverse effects of daily flow operation at power stations; and a historical review of the utilization of the rivers Silkajoki, Pyhajoki and Kalajoki. (Moore-IVI)
W85-02385

EFFECTS OF ENVIRONMENTAL CHANGES ON THE FISHERIES AND FISH STOCKS IN THE ARCHIPELAGO SEA AND THE FINNISH PART OF THE GULF OCH BOTHNIA,
Helsinki Univ. (Finland). Dept. of Limnology.
For primary bibliographic entry see Field 5C.
W85-02388

TROPICAL LAKES - FUNCTIONAL ECOLOGY AND FUTURE DEVELOPMENT: THE NEED FOR A PROCESS-ORIENTED APPROACH,
Oslo Univ. (Norway). Zoological Inst.
For primary bibliographic entry see Field 2H.
W85-02408

WATER QUALITY IMPLICATIONS OF ARTIFICIAL FLOW FLUCTUATIONS IN REGULATED RIVERS,
Loughborough Univ. of Technology (England). Dept. of Geography.
For primary bibliographic entry see Field 2K.
W85-02413

EFFECT OF FOREST AMELIORATION ON DIVERSITY IN AN OMBROTROPHIC BOG,
Helsinki Univ., Lammi (Finland). Lammi Biological Station.
H. Vasander.
Annales Botanici Fennici, Vol. 27, No. 1, p 7-15, 1984. 2 Fig, 3 Tab, 66 Ref.

Descriptors: *Forestry, *Environmental effects, *Bogs, *Laaviosuo Bog, *Finland, Ecosystems, Plants, Species diversity, Biomass, Eutrophication.

In a continuation of the study of the Laaviosuo bog ecosystem, the biomass diversity and abundance relationships were examined in different sites and communities. Diversity was calculated from the biomass of plant species in different microsites on virgin, drained and drained/fertilized sections of an ombrotrophic bog in southern Finland. On virgin bog the diversity increased from wet and moist hollows to low hummocks. On high hummocks the diversity was decreased by the dominance of Scots pine and ericoid dwarf shrubs. On drained bog the diversity was lower in all plant comunities than on virgin bog, except in the moist hollows, where the proportion of the dominant species had decreased. On drained, fertilized bog the diversity was lower in all plant commnities than on virgin bog, except in the hollows, where the proportion of the dominant species had decreased and which had been colonized by typical hummock species. The total diversity decreased from virgin to drained and fertilized bog, reflecting a general trend in eutrophicated or disturbed ecosystems. During the succession following drainage, biomass and production usually increased, but diversity decreased. (Baker-IVI)
W85-02484

DETERMINATION OF MINIMUM DISCHARGE FOR O+ BROWN TROUT (SALMO TRUTTA L.) USING A VELOCITY RESPONSE,
R. N. B. Campbell, and D. Scott.
New Zealand Journal of Marine and Freshwater Research, Vol. 18, No. 1, p 1-11, 1984. 4 Fig, 7 Tab, 46 Ref.

Descriptors: *Trout, *Fish behavior, *Flow discharge, *Velocity, *Silverstream, *New Zealand, Water currents, Ecological distribution, Shoaling behavior, Pools, Aquatic habitats.

Discharge criteria are being developed which are designed to protect fish in situations where water abstraction is at significant levels. The effects of decreasing discharge on the behavior and distribution of O+ brown trout were studied in the Silverstream, a tributary of the Taieri River, Otago, New Zealand. Water is abstracted for domestic use; the

estimated mean annual discharge after abstraction is 1.17 cu m/s. Before 1972, leakage from the pipeline was sufficient to maintain a population of trout in the lower Silverstream, but improvements to the line resulted in absence of surface flow in dry periods. The trout population now is almost entirely of age classes O+ and 1+ for most of the year, with a spawning run of large trout from the Taieri during the winter. The preferred habitat is runs, where the behavior is territorial, but with decreasing discharge most of the population moved into pools and adopted shoaling behavior. Current velocity was the significant factor, with a threshold value of 0.30 m/s for poolward movement. The discharge giving a mean run velocity of 0.30 m/s was compared with empirical criteria for minimum satisfactory flows for fish, and very close agreement was found. (Moore-IVI)
W85-02505

STREAM ECOSYSTEMS IN MOUNTAIN GRASSLAND (WEST CARPATHIANS); 1. INTRODUCTION AND DESCRIPTION OF THE INVESTIGATED AREA,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
A. Kownacki.
Acta Hydrobiologica, Vol. 24, No. 4, p 291-305, 1982. 3 Fig, 2 Tab, 18 Ref.

Descriptors: *Land use, *Runoff, *Erosion, *Permeability, *Poland, Soil properties, Ecosystems, Streams, West Carpathians, Hydrography.

The investigations were carried out in the upper Grajcarek catchment basin, in the region of the village Jaworki (the West Carpathians). The soils in the catchment basin are vulnerable to erosional processes whose intensity is limited by the forest and pastural land use. The perviousness of brown and podzolic soils varies and depends on the way they are used. On arable land the speed of percolation is 35 mm/min. In forests it falls to 2.5 mm/min, while on pastures it is reduced to as little as 0.7 mm/min. The possibility of surface run-off on slopes under pasture thus increases considerably. Streams investigated included Biala Woda, Czarna Woda, and Kamionka. (Baker-IVI)
W85-02512

STREAM ECOSYSTEMS IN MOUNTAIN GRASSLAND (WEST CARPATHIANS); 4. HEAVY METALS,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
For primary bibliographic entry see Field 5B.
W85-02515

STREAM ECOSYSTEMS IN MOUNTAIN GRASSLAND (WEST CARPATHIANS); 8. BENTHIC INVERTEBRATES,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
For primary bibliographic entry see Field 5G.
W85-02519

STREAM ECOSYSTEMS IN MOUNTAIN GRASSLAND (WEST CARPATHIANS); 9. OLIGOCHAETA,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
For primary bibliographic entry see Field 5B.
W85-02520

FLOW REQUIREMENTS FOR RECREATION AND WILDLIFE IN NEW ZEALAND RIVERS - A REVIEW,
Ministry of Works and Development, Christchurch (New Zealand).
For primary bibliographic entry see Field 6D.
W85-02558

7. RESOURCES DATA

7A. Network Design

STATISTICAL PROCEDURES FOR APPLYING HILSENHOFF'S BIOTIC INDEX,
Wisconsin Dept. of Natural Resources, Madison. Water Quality Evaluation Section.
For primary bibliographic entry see Field 5A.
W85-02245

USE OF NEPHELOMETRIC TURBIDITY TO CALCULATE CARLSON'S TROPHIC STATE INDEX IN KEYSTONE LAKE OKLAHOMA,
Corps of Engineers, Vicksburg, MS.
For primary bibliographic entry see Field 2H.
W85-02248

SYSTEMATIC PROBLEM-ORIENTED APPROACH TO HYDROLOGICAL DATA REGIONALISATION,
Vrije Univ., Amsterdam (Netherlands). Dept. of Hydrogeology and Geographical Hydrology.
For primary bibliographic entry see Field 2A.
W85-02459

SENSITIVITY OF FLOW MEASUREMENT TO STAGE ERRORS FOR NEW ZEALAND CATCHMENTS (NOTE),
Ministry of Works and Development, Wellington (New Zealand).
For primary bibliographic entry see Field 2E.
W85-02559

COMPUTER MODELLING OF RESERVOIR NETWORKS AND HYDROELECTRIC PLANTS,
Main (Charles T.), Inc., Boston, MA.
For primary bibliographic entry see Field 8A.
W85-02680

7B. Data Acquisition

DETERMINATION OF INORGANIC ANIONS IN RIVER WATERS BY COLUMN-COUPLING CAPILLARY ISOTACHOPHORESIS,
Komenskeho Univ., Bratislava (Czechoslovakia). Dept. of Analytical Chemistry.
I. Zelensky, D. Kaniansky, P. Havasi, and V. Lednarova.
Journal of Chromatography, Vol. 294, p 317-327, June, 1984. 5 Fig, 5 Tab, 24 Ref.

Descriptors: *Isotachophoresis, *Anions, *Inorganic compounds, *Chemical analysis, Sulfates, Chlorides, Nitrates, Nitrites, Fluorides, Phosphates, Ion chromatography, Water analysis.

Concentrations of sulfate, chloride, nitrate, nitrite, fluoride and phosphate in river water have been suitably determined using suppressed and nonsuppressed ion chromatography with conductivity and/or photometric detectors. These methods are instrumentally simple but sample pretreatment and analysis of individual aliquots may be necessary. Column-coupling capillary isotachophoresis permitted the simultaneous determination of Cl(-), NO3(-), SO4(2-), NO2(-), F(-) and PO4(3-) in river water; the time for the complete analysis of both macro- and micro-constituents was about 25 min and no sample pretreatment was needed. Detection limits for constituents that are present in river water at lower concentrations (NO2(-), F(-) and PO4(3-)) were in the range 30-60 pmoles. In spite of observed partial decomposition of NO2(-) during the separation, the determination of nitrite at concentrations down to 0.1 ppm is possible using the proposed operating conditions. (Collier-IVI)
W85-02304

TRACE ANALYTICAL PROCEDURES WITH MODERN VOLTAMMETRIC DETERMINATION METHODS FOR THE INVESTIGATION AND MONITORING OF ECOTOXIC HEAVY METALS IN NATURAL WATERS AND ATMOSPHERIC PRECIPITATES,
Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Angewandte Physikalische Chemie.
H. W. Nurnberg.
Science of the Total Environment, Vol. 37, No. 1, p 9-34, July, 1984. 7 Fig, 2 Tab, 75 Ref.

Descriptors: *Voltammetry, *Trace metals, *Heavy metals, *Trace levels, *Chemical analysis, Water analysis, Cadmium, Measuring instruments, Atomic absorption spectrometry, Potentiometry, Detection limits.

The voltammetric approach with differential pulse modes is superior to atomic absorption spectrometry for the determination of ecotoxic heavy metals and metalloids in natural waters. Voltammetry is an oligo-substance method which enables the simultaneous determination of several metals in the same run. Due to its extraordinary determination sensitivity, voltammetry enables speciation studies to be made at more realistically low overall levels of dissolved heavy metals than do other methods such as potentiometry. When the differential pulse mode was used in connection with the electrochemical preconcentration techniques applied in differential pulse stripping voltammetry (DPSV) or adsorption differential pulse voltammetry (ADPV), the ultimate sensitivity limit of the method was not reached in practice; determinations are possible down to heavy metal trace concentrations of 0.001 micro g/L and, in exceptional cases, even more than one order of magnitude lower, as has been demonstrated for Cd in arctic snow. At present, the attainable determination limit is not set by the voltammetric properties, but by practical facts stemming from the small blank levels that remain even under ultraclean working conditions at those ultra-trace levels. For exploitation of the full potential of voltammetry, the method should be applied in connection with appropriate, advanced, and reliable sampling and sample pretreatment procedures. (Collier-IVI)
W85-02306

ELECTROCHEMICAL SPECIATION OF TRACE METALS IN SEA WATER,
Akademie der Wissenschaften der DDR, Rostock-Warnemuende. Inst. fuer Meereskunde.
L. Brugmann.
Science of the Total Environment, Vol. 37, No. 1, p 41-60, July, 1984. 6 Fig, 4 Tab, 122 Ref.

Descriptors: *Trace metals, *Seawater, *Electrochemistry, *Chemical analysis, Polarography, Voltametry, Potentiometry, Instrumentation, Lead, Copper, Speciation.

Various approaches, such as bioassays, computer-assisted modelling and direct measurement following physical separation are currently being used to investigate the speciation of trace metals in sea water. The electrochemical techniques used successfully as a necessary prerequisite for the experiments involved include conventional polarography, anodic stripping voltammetry (ASV) and potentiometry. Differential pulse anodic stripping voltammetry (DPASV) using mercury film electrodes enables direct studies in ultratrace levels present in non-contaminated ocean waters. By varying the conditions of the sample chemistry and electroanalysis it is possible to characterize metal-organic interactions. This is demonstrated in the case of natural sea water samples subjected to ASV diagnosis. Differences in the Pb and Cu values yielded for Baltic waters by two methods based on DPASV and AAS are discussed with regard to speciation. An analysis of the existing literature is used to briefly summarize the needs of future research. Important problems requiring a more precise quantitative analysis include the adsorption of organics on electrodes and the kinetics and thermodynamic constants of chelates with special regard to the physico-chemical nature of metal-humic substances. The introduction of new and improved electroanalytical techniques and equipment for speciation studies is strongly recommended. (Author's abstract)
W85-02308

ELECTROCHEMICAL DETERMINATION OF POLLUTANTS IN SEA WATER: TOXIC SUBSTANCES AND NUTRIENTS,
Marie Curie-Sklodowska Univ., Lublin (Poland). Dept. of Analytical Chemistry and Instrumental Analysis.
K. Sykut, and R. Dumkiewicz.
Science of the Total Environment, Vol. 37, No. 1, p 91-94, July, 1984. 21 Ref.

Descriptors: *Electrochemistry, *Seawater, *Chemical analysis, *Nutrients, *Heavy metals, Phosphorus, Ammonium, Nitrates, Nitrites, Ion selective electrodes, Voltametry.

Coastal marine waters have a wide variety of important human uses and therefore must be protected against contamination. The main sources of their pollution (by toxic substances and nutrients) are the discharge of municipal sewage and runoff from agricultural areas. Excessive nutrient enrichment in the form of inorganic nitrogen (NH4(+), NO2(-), NO3(-)) may be directly estimated by the use of ion selective electrodes (ISE), whereas the inorganic phosphorus can only be estimated indirectly. The total content of N, P and heavy metals may be estimated after decomposition of organic substances, using the ISE method in the case of P and N determination and the differential pulse anodic stripping voltammetry (DPASV) method for determining the heavy metals. (Author's abstract)
W85-02312

ELECTROCHEMICAL METHODS AND SENSORS FOR MONITORING OF WATER,
Ceskoslovenska Akademie Ved, Prague. J. Heyrovsky Inst. of Physical Chemistry and Electrochemistry.
J. Tenygl.
Science of the Total Environment, Vol. 37, No. 1, p 113-120, July, 1984. 4 Fig, 22 Ref.

Descriptors: *Electrochemistry, *Electrodes, *Passivation, Calibration, Microprocessor control, Reactivation, Chemical analysis, Chemical oxygen demand, Biological oxygen demand.

Continuous monitoring of water for various substances is made difficult by the passivation of the electrochemical sensors which causes a change (usually a decrease) of the signal during prolonged contact with contaminated water. Passivation is usually caused by a combination of several effects such as oxidation, deposition, or slime growth. Frequent calibration and zeroing elimates the effect of passivation as well as of changes in physical parameters. Introduction of the automatic calibration and zeroing with microprocessor control opens up new possibilities for long term analysis. A very efficient method to protect the electrode is covering its surface with a thin membrane made of polyethylene, teflon, or other plastics. Only gases or volatile substances can diffuse through the membrane to the electrode surface while ionic species and impurities cannot penetrate. Many mechanical, chemical, physical, and various electrochemical methods have been developed for reactivating sensors. A rotating mercury pool membrane electrode was used for the continuous determination of metal ions in water. For reactivation of the solid electrodes in the anodic region, a thermal regeneration of the electrode was developed with a heated wire electrode. Methods for the determination of the species after its transfer from the water phase into a gas stream are used for determining chemical oxygen demand and biological oxygen demand. (Collier-IVI)
W85-02315

ION SELECTIVE ELECTRODES FOR MEASUREMENTS IN FRESH WATERS,
Rome Univ. (Italy). Ist. di Chimica Analitica.
M. Mascini, and A. Liberti.
Science of Total Environment, Vol. 37, No. 1, p 121-128, July, 1984. 1 Fig, 1 Tab, 6 Ref.

Descriptors: *Ion selective electrodes, *Potentiometry, *Somalia, Well water, Detection limits, Fluorides, Chemical analysis.

Ion selective electrodes (ISE), now commonly employed for measurements in fresh waters, are simple, sturdy, and reliable. Samples need only a minor pretreatment before being appropriate for analysis. The detection limit of a potentiometric measurement is usally in the range of 10 to the -5 power M to 10 to the -6 power M. Several features make potentiometry very attractive as an analytical method in water analysis. One advantage is that measurements can be performed in field conditions with portable instruments, this feature is of considerable importance in environmental monitoring of water quality, especially when storage and transportation may be sources of errors in analytical determinations. Applications of the ISE in field measurements have been realized in a Somalia survey with simple equipment. The water wells of several desert districts were characterized with the aim of evaluating future residential and cattle raising areas. About 100 wells were analyzed in a desert area located far from any village. Through this survey, experimental evidence was obtained of endemic illness of nomadic populations due to the high fluoride content of some wells. (Collier-IVI)
W85-02316

MODELS AND STRATEGY FOR TAKING MEASUREMENTS IN WATER AND IN THE AIR (MODELISATION ET STRATEGIE DE LA MESURE DANS L'EAU ET DANS L'AIR),
J. Jacquet.
Houille Blanche, No. 1/2, p 67-78, 1984. 1 Fig, 15 Ref.

Descriptors: *Measuring instruments, *Model studies, Water analysis, Monitoring, Water quality control.

In order to devise models to show changes in phenomena occurring in aquatic and atmospheric media, it is necessary to at the same time devise suitable measurement strategies for acquiring data necessary to create, calibrate and validate such models. Different stages of computing models for a complex system of ecological proportions are used as proof to illustrate this statement from the aspect of systems analysis. Significant examples are provided from research into the atmospheric water cycle. These studies were undertaken to highlight man's influence on the behavior of natural surroundings. Strategies involving permanent metering networks are particularly emphasized. These form the corner-stone for devising ways and means of effectively administering areas of the biosphere. A review must also be made of the administration of the metering networks themselves in order to guarantee that they continue to function economically and to provide reliable information. (Baker-IVI)
W85-02352

CUT-THROAT FLUME CHARACTERISTICS,
Monash Univ., Clayton (Australia). Dept. of Civil Engineering.
R. J. Keller.
Journal of Hydraulic Engineering, Vol. 110, No. 9, p 1248-1263, September, 1984. 8 Fig, 2 Tab, 8 Ref.

Descriptors: *Flumes, *Measuring instruments, *Cut-throat flumes, Open channels, Flow, Stream flow.

The characteristics of cut-throat flow measuring flumes are examined with special attention to scale effects and the transition submergence at which the flow regime changes from undrowned to drowned. The results for undrowned flumes indicate a small scale effect at low flow rates only. The scale effect is completely eliminated by adjusting the data to correct for dissimilar boundary layer growth. For drowned flow there was no scale effect for relative submergences below 0.85. Above this value an apparent scale effect is noted although it is of little practical consequence. The value of transition submergence is nonconstant and dependent on the discharge through the structure. Hydraulic model testing of cut-throat flumes to obtain prototype submerged rating data is feasible, provided the entrance and exit conditions are correctly modeled and the submergence ratio is kept below 0.85. At higher submergence there is an apparent significant scale effect which is not fully explained by the present studies. The transition submergence at which the flow regime changes from undrowned to submerged, is itself a function of the discharge through the flume. In the present study values ranging from 52 to 95% were measured. Cut-throat flumes are most accurate when operated in the undrowned mode. If submerged flow is unavoidable, cut-throat flumes should not be operated at submergences greater than 0.85. (Baker-IVI)
W85-02453

ERRORS IN LEVEL RECORDER DATA: PREVENTION AND DETECTION,
Agricultural Univ., Wageningen (Netherlands). Dept. of Land and Water Use.
S. Van der Schaaf.
Journal of Hydrology, Vol. 73, No. 3/4, p 373-382, August, 1984. 2 Fig, 2 Tab, 4 Ref.

Descriptors: *Water level, *Measuring instruments, *Errors, Error analysis, Computers.

The occurrence of errors in water-level recorder data can be reduced by both prevention and detection with subsequent correction. For effective prevention, the error sources should be known. Error sources in the conversion steps include zero-level shift, nonlinearity, hysteresis, scale factor, repeatability, environmental variations, timing, and code deformation. For effective detection, knowledge of error symptoms and their relationship with error sources is essential. The effectiveness of both error prevention and detection depends on field precautions, the quality and frequency of field checks and field check reports, on the quality of equipment maintenance and, as far as detection/correction is concerned, on the sampling interval. Errors in the data should be detected by a computer program, not manually. A computer produced error report and field-check reports are necessary for errors in the data to be corrected. (Baker-IVI)
W85-02495

RAPID BIOLOGICAL METHOD FOR THE MONITORING OF EUTROPHICATION,
National Board of Waters, Helsinki (Finland). Water Research Inst.
P. Heinonen, and S. Herve.
Archiv fur Hydrobiologie, Vol. 101, No 1/2, p 135-142, August, 1984. 2 Fig, 2 Tab, 7 Ref.

Descriptors: *Measuring instruments, *Filters, *Eutrophication, *Monitoring, Filter media, Glass fiber filters, Lakes.

A new, rapid biological method for the monitoring of watercourse eutrophication is described. The method is based on the use of glass fiber filters as artificial substrate. The test filters were incubated both in rivers and in a lake. Various combinations of filter material were employed. A single glass fiber filter was found unsuited for use in lake waters due to its mechanical weakness. Single and double glass fiber filters with plastic sheet over one side or between the two fibers proved unsatisfactory as removing the plastic sheets considerably slowed the process. The best results were obtained using a double glass fiber filter. (Baker-IVI)
W85-02526

SIMPLE FIELD METHOD FOR CONCENTRATION OF VIRUSES FROM LARGE VOLUMES OF WATER,
Arizona Univ., Tucson. Dept. of Microbiology and Immunology.
G. A. Toranzos, C. P. Gerba, and H. Hanssen.
Applied and Environmental Microbiology, Vol. 48, No. 2, p 431-432, August, 1984. 1 Fig, 1 Tab, 9 Ref.

Descriptors: *Water sampling, *Sample preparation, *Viruses, *Concentration, Water quality control, Sampling, Field tests, Microporous filters.

A lightweight, low-cost, plastic spray tank had been developed for use in concentrating viruses from water with microporous filters. The system is able to process from 10 to more than 22 liters of finished tap water with the 47 mm diameter filters

and from 22 to more than 154 liters with the 142 mm diameter filters. The device was successfully used in recent field studies to concentrate viruses onto positively charged 30S Zeta-plus and 1-MDS Virozorb filters. These filers have an advantage over negatively charged filters in that pH adjustment or addition of cation salts is not required before processing the water. The effect of turbidity on the volumes which could be processed is discussed. (Baker-IVI)
W85-02603

APPLICATION OF DERIVATIVE SPECTROSCOPY IN BIOASSAYS ESTIMATING ALGAL AVAILABLE PHOSPHATE IN LAKE SEDIMENTS,
Hoogheemraadschap van Rijnland, Leiden (Netherlands).
For primary bibliographic entry see Field 5A.
W85-02615

BOREHOLE METHODOLOGY FOR HYDROGEOCHEMICAL INVESTIGATIONS IN FRACTURED ROCK,
National Hydrology Research Inst., Ottawa (Ontario).
D. J. Bottomley, J. D. Ross, and B. W. Graham.
Water Resources Research, Vol. 20, No. 9, p 1277-1300, September, 1984. 20 Fig, 2 Tab, 23 Ref.

Descriptors: *Sampling, *Groundwater, *Boreholes, *Hydrogeochemistry, Geological fractures, Permeability coefficient.

The major complications in obtaining representative samples from boreholes in low permeability fractured rock include contamination from drilling fluid, vertical mixing in open holes of groundwater of different chemistries between fractures of different hydraulic head, and low hydraulic conductivity fractures which limit the rate at which groundwater can be pumped to the surface. A geochemical probe controlled and operated with an umbilical cable system has been field tested to a depth of 600 m in a multilevel ported casing at the Chalk River Nuclear Laboratories (CRNL), Chalk River, Ontario. The probe provides in situ measurements of pH, redox potential, dissolved oxygen, temperature, conductivity, and pressure while allowing groundwater sample collection both at surface and downhole. The multilevel ported casing preserves the subsurface hydrogeochemical zonation and facilitates sampling at various depths. In the CRNL borehole, dilute Na/HCO3 and Na/Cl waters ranging in age from 500 to 12,000 years have been observed in gneissic rock at depths of 85 to 350 m. Accurate hydrogeochemical characterization of the low-permeability metagabbro present from 400 to 600 m has been frustated by contamination from casing installation water. Modifications in the design of the casing are required so that the casing can be installed rapidly and the casing packers inflated without the introduction of nonindigenous fluids. (Moore-IVI)
W85-02670

DEFLECTION MEASUREMENTS OF THE UPSTREAM ASPHALTIC MEMBRANE OF MARCHLYN DAM,
For primary bibliographic entry see Field 8D.
W85-02682

8. ENGINEERING WORKS

8A. Structures

CALCULATION OF COMPLETE INTERCEPTION OF GROUNDWATER INFLOW TO 'PERFECT' TRENCHES BY LIGHT WELLPOINT INSTALLATIONS,
For primary bibliographic entry see Field 4B.
W85-02229

CALCULATION OF THE LINING OF A NONCIRCULAR TUNNEL,
V. F. Ilyushin.
Hydrotechnical Construction, Vol. 17, p 627-632, December, 1983. 2 Fig, 4 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 12, p 25-28, December, 1983.

Descriptors: *Tunnel construction, *Linings, Tunnel linings, Concrete, Reinforced concrete, Mathematical equations, Hydroelectric plants.

High-head hydroelectric stations located in mountainous regions have underground structures on which one of the main loads is the pressure of groundwaters. The most common noncircular cross-sectional shape of a tunnel is the horseshoe with a crown outlined over the arc of a circle and flat walls and invert. Such a shape is the most technologically efficient during construction. The lining has usually a minimum design thickness and can be concrete or reinforced. The reinforcement is installed in the crown in conformity with the diagram of moments and in the walls and invert in the middle of the lining thickness. The lining is equipped with drainage reducing the pressure of the groundwaters to a practically acceptable value. Residual pressure is absorbed by the lining of the crown having an efficient axis outlined over the arc of a circle and by the flat walls and invert transmitting forces through the anchors to the surrounding rock mass. There are no restrictions with respect to the conditions of hydraulics and seepage with respect to cavitation erosion and abrasion, and permissible gradients of the seepage flow through the lining. Methods are given for calculating the crown, concrete wall and invert, anchors, and concrete-rock walls and invert. (Baker-IVI)
W85-02230

WEDGE-WIRE INTAKE SCREENS FOR SHALLOW SAND-BED RIVER,
Iowa Univ., Iowa City. Inst. of Hydraulic Research.
R. Ettema, and J. C. Johnson.
Journal of Hydraulic Engineering, Vol. 110, No. 8, p 1139-1144, August, 1984. 4 Fig, 1 Ref.

Descriptors: *Screens, *Intakes, *Hydroelectric plants, *Kansas River, Water supply development, Powerplants, Filters, Sand, Soil properties.

The Kansas River near Belvue Kansas was selected as an alternate source of make-up water for the Jeffrey Energy Center's condenser cooling system. The river is a relatively shallow sandbed river of constantly changing bottom geometry. Wedge-wire intake screens have been an effective and practical means of drawing water from the river, provided that the screens are positioned in a protective enclosure such as a trough. The local flow field around the trough generally acts to prevent accumulation of sediment near the intake screens and a system of water jets can be applied to successfully sluice sediment from the trough. For the JEC river intake, two pairs of water jets effectively sluice the trough. The upstream pair, which are at the end of the trough, will be applied initially. After a sufficient period, the second pair, which are located under the downstream screen, are consecutively applied. (Baker-IVI)
W85-02268

OPTIMAL CHANNEL CROSS SECTION WITH FREEBOARD,
Colorado Univ. at Denver. Dept. of Civil and Urban Engineering.
C.-Y. Guo, and W. C. Hughes.
Journal of Irrigation and Drainage Engineering, Vol. 110, No. 3, p 304-314, September, 1984. 7 Fig, 1 Tab, 5 Ref.

Descriptors: *Channels, *Construction costs, *Design criteria, *Optimization, Geometry, Mathematical equations, Cost analysis, Friction, Freeboard.

An analytical procedure is presented for determining the dimension of an open channel, including freeboard, which either minimizes frictional resistance or minimizes construction cost. The least-cost solutions indicate the importance of including the channel width in the formulation of channel cost function, since otherwise the solution always results in a wide shallow channel. A graphical method is suggested which simplifies the computations required to determine a hydraulically optimum trapezoidal channel cross section. Owing to the regionalization of construction costs, the solutions for the least-cost trapezoidal channel cross section can only be expressed as a function of those constraints involved in the localized channel cost function. By analyzing historical cost data near the site or summing estimates of idividual channel costs, the proposed channel construction cost function can be established and a general expression for the least cost trapezoidal channel cross section can be reduced to a solvable stage. Similar figures to those shown for the minimum resistance channel cross section can be also produced for the least cost channel section. (Baker-IVI)
W85-02448

TRENDS IN PUMPED-STORAGE DEVELOPMENT,
Acres Consulting Services Ltd., Toronto (Ontario).
J. G. Warnock, and B. L. Smith.
International Water Power and Dam Construction, Vol. 36, No. 8, p 15-19, August, 1984. 3 Fig, 3 Tab.

Descriptors: *Pumped storage, *Design criteria, *Construction, *Reservoirs, Pumps, Turbines, Liners, Water management, Water resources development.

Various trends emerging in pumped-storage development are described with particular attention given to those trends which influence flexibility of performance, effectiveness in meeting rapid changes in system demand, load frequency control and economy in relation to other means of providing the same system services. The concept of underground pumped hydro is also mentioned. Notable trends in the design and construction of the civil works of pumped storage projects include the evolution of a reliable type of lined reservoir, geotechnical investigations of increasing complexity and detail, ever-increasing heads where permitted by geology and topography, a limited use of prestressed reinforced concrete as a substitute for steel liners in pressure tunnels, a dramatic increase in the use of underground locations for power stations, an awareness of environmental considerations, and the further development of the asphaltic-lined type of reservoir in connection with underground pumped storage. (Baker-IVI)
W85-02672

PUMPED-STORAGE: PEAK GENERATION OR OPERATING RESERVE,
M. Monti, P. Sandrin, and J. P. Gonot.
International Water Power and Dam Construction, Vol. 36, No. 8, p 20-23, August, 1984. 5 Fig, 2 Ref.

Descriptors: *Pumped storage, *Model studies, *DEMETER, *France, Design criteria, Planning, Water management, Optimization.

The trade-off which must be established between the various functions of pumped-storage plants is examined. A compromise between supply security and economic planning can be found only by coordinated planning of pumped-storage units and thermal generation plants. A model used by Electricite de France (EDF) to ensure optimized daily planning of thermal and pumped-storage units is described. The model, called the DEMETER model, ensures the optimization of the daily planning of thermal and pumped-storage plants. The model iterates between two levels: coordination where the prices of the generated energy and the operating reserve are determined to adjust generation to load and keep a sufficient reserve; and decomposition where the schedule of each unit is optimized on the basis of the above prices and taking into account local constraints such as unavailability, and minimum shut down time. The role of EDF is to supply customers with energy while seeking the lowest generation cost. As electricity cannot be stored in its original form, only that which can be used should be generated. (Baker-IVI)
W85-02673

PUMPED STORAGE FOR THE GERMAN RAILWAY,
Energy Engineering International, Munich (Germany, F.R.).
H. Reges.
International Water Power and Dam Construction, Vol. 36, No. 8, p 35-36, August, 1984. 2 Fig, 2 Tab.

Descriptors: *Pumped storage, *Design criteria, *Water management, *West Germany, Railways, Energy, Construction, Pumps, Turbines, Electrical equipment.

The Langenprozelten pumped-storage plant supplies the German railway with peak energy. It obtains its pump energy from the German railway network and feeds energy back into this network by being operated as a generator. The upper reservoir of the plant is located on the Sohlhohe hill and the lower reservoir in a valley 300 m below. Each of the two vertical machine sets installed in the plant consists of a pump-turbine, a starting turbine and a synchronous generator. An approximately 1300 m long pressure pipeline, with an interior diameter of 3.9 m, connects the upper reservoir with the powerplant. The powerplant is a shaft structure with a rectangular plan, located in the center of the dam of the lower reservoir. Electromechanical equipment described in the article includes pump turbines, starting turbines, synchronous generatores and accompanying electrical equipment. (Baker-IVI)
W85-02675

MODULAR EQUIPMENT FOR THE AUTOMATIC CONTROL OF SMALL HYDRO PLANTS,
Hidroelectrica Espanola, Madrid.
J. Regoyos, and G. Gomez.
International Water Power and Dam Construction, Vol. 36, No. 9, p 18-21, September, 1984. 6 Fig.

Descriptors: *Computers, *Microcomputers, *Automation, *Hydroelectric plants, Management, Water management.

The application of a microcomputer and an assembly of modular equipment for the automatic control of three small run-of-river plants is described. The systems controlled by the modular set up include gates, turbines with adjustable runner blades, induction generators, speed increasers, turbine and generators system, circuit breakers, power transformers, auxiliary supplies and condenser batteries. The stages of research in developing a system suitable for easy application for any small hydro plant are as follows: analysis of the automation of different kinds of small hydroplants and definition of basic control criteria for them; definition of the auxiliary devices which collect the data for the control microcomputer; modular standardized development of the common systems; definition of the control functions; definition and development of the starting and stopping sequences, and the ways of tripping the unit; preparation of technical specification of the control microcomputer; design of a prototype microcomputer; simulation tests of the microcomputer and auxiliary systems; and installation and operation tests in three small hydro plants. (Baker-IVI)
W85-02679

COMPUTER MODELLING OF RESERVOIR NETWORKS AND HYDROELECTRIC PLANTS,
Main (Charles T.), Inc., Boston, MA.
C. K. Sarkar.
International Water Power and Dam Construction, Vol. 36, No. 9, p 22-24, September, 1984. 4 Fig.

Descriptors: *Computer models, *Hydroelectric plants, Automation, Optimization, Water management, Simulation, Reservoir networks, Model studies.

HYMS (Hydroelectric Simulation) is a general purpose hydroelectric simulation model having the capability of simulating precisely almost any hydroelectric plant and reservoir system, large or small, simple or complex. Computations may be performed at a desired level of accuracy consistent with the availability of new input data. The program may be used to study the feasibility of new developments and their impacts on exising systems, effects of changes in operational procedures in an existing system, or at any component plant. It can be used to determine hydroelectric power potential in a river basin, to help optimize reservoir sizes, dam heights, plant sizes and expansions, sizes of penstocks and tailrace tunnels/channels, determine reservoir and plant operating procedures, and the like. It is a versatile, flexible and powerful tool. (Baker-IVI)
W85-02680

DESIGN AND CONSTRUCTION OF THE AGUS IV POWER CAVERN, PART THREE: CONTROL OF BEHAVIOR,
Lahmeyer International G.m.b.H., Frankfurt am Main (Germany, F.R.).
K. Honisch, and H. Schranz.
International Water Power and Dam Construction, Vol. 36, No. 9, p 51-56, September, 1984. 6 Fig, 3 Tab, 2 Ref.

Descriptors: *Power cavern, *Design criteria, Construction, Measuring instruments, Tunnels, Excavation, Anchor load, Deformation.

The monitoring of a sufficient and representative amount of rock deformations and anchor loads is an indispensible part of a non-rigid method to excavate large underground openings safely. One of the new methods is the New Austrian Tunnelling Method (NATM) which has been applied for the cavern of the Agus IV hydroelectric project. The instrumentation for the cavern of the Agus IV project consisted of 26 multiple and five single extensometers, seven convergency cross sections with up to ten measured distances and 26 disc load cells. Geodetic surveying has supported the measurements. Because of blasting, breakage and non-operational times of bolts, the convergency measurements provided only 50% of the data expected, while the extensometers gave about 85% reasonable results. The performance of the cavern has demonstrated the presence of homogeneous almost linear elastic, isotropic rock, with a deformability described by Young's modulus of 1750 MN/sq m. Consolidation grouting has improved the rock quality up to a Young's modulus of 2000 MN/sq m. An integral part of the excavation using the NATM is the immediate evaluation of deformations. Two independent but simultaneous measuring techniques are required. (Baker-IVI)
W85-02683

8B. Hydraulics

PERTURBATION SOLUTION FOR DAM-BREAK FLOODS,
Canterbury Univ., Christchurch (New Zealand). Dept. of Civil Engineering.
B. Hunt.
Journal of Hydraulic Engineering, Vol. 110, No. 8, p 1058-1071, August, 1984. 7 Fig, 12 Ref.

Descriptors: *Dam construction, *Flood control, *Mathematical equations, Perturbation, Kinematic waves.

The method of matched asymptotic expansions has been used to calculate an approximate solution for a dam-break flood. This work suggests that the solution becomes asymptotically valid after the wave front (shock) has advanced about four reservoir lengths downstream. Calculations show that depth hydrographs downstream from this point are virtually independent of the way in which mass is initially distributed within the reservoir and that a significant simplification of the mathematical solution can be achieved by modeling the reservoir with a point source of mass. The solution away from the leading edge of the flood wave is given by the kinematic-wave approximation, which results from neglecting depth-gradient and acceleration terms in the momentum equation. The solution near the leading edge of the flood wave is obtained by neglecting accelerations and including the bed-slope, bed-resistance and depth-gradient terms in the momentum equation. This suggests that results given by the closed-form approximation are virtually identical with results obtained from the zero-inertia or diffusion analogy numerical methods. Comparisons with experiment show good qualitative agreement. (Baker-IVI)
W85-02264

ONE-DIMENSIONAL MODELS FOR PARTIALLY BREACHED DAMS,
Utah Univ., Salt Lake City. Dept. of Civil Engineering.
D. R. Schamber, and N. D. Katopodes.
Journal of Hydraulic Engineering, Vol. 110, No. 8, p 1086-1102, August, 1984. 13 Fig, 14 Ref. NSF grant ENG 73-04233 A01.

Descriptors: *Dam failure, *Flow, Model studies, Dam breach, Mathematical models, Unsteady flow, Floods.

Under the assumption that the rapidly varied flow in the vicinity of a partial breach can be treated as an internal boundary condition, one-dimensional models based on the complete unsteady flow equations gave satisfactory results for the cases studied. A theory for flow through a partial dam failure is presented which identifies three distinct flow conditions at the breach: free flowing/supercritical condition; free flowing/subcritical conditions and submerged condition. These conditions are formulated in terms of fundamental mass, momentum, and energy considerations written for specific sections in the breach vicinity and coupled with appropriate characteristic relations written for gradually varied unsteady flow. The theory is tested for various cases of breach width and channel roughness. The numerical computations agree favorably with the available experimental data. The economy of computation resulting from these one-dimensional approximations is tremendous and the use of such models whenever possible is highly desirable. Such models provide no information on the longitudinal extent of the convergent-divergent, two-dimensional flow in the vicinity of the breach. The consideration of such phenomena is indeed appropriate for a floodwave emanating from a breached dam onto an unbounded plain, with no confining side walls. (Baker-IVI)
W85-02266

FLOW ANALYSES IN IDEALIZED RUBBLE-MOUND BREAKWATER,
Kanazawa Inst. of Tech. (Japan). Dept. of Civil Engineering.
K. Mizumura.
Journal of Waterway, Port, Coastal and Ocean Engineering, Vol. 110, No. 3, p 344-355, August, 1984. 12 Fig, 1 Tab, 5 Ref.

Descriptors: *Flow characteristics, *Breakwaters, Mathematical equations, Flow channels, Wave action, Water currents.

Wave-induced currents in rubble-mound breakwaters are analyzed. Particular regard is given to the modeling of flow channels and computing by method of characteristics. The horizontal water motion by incident wave at the leading points of the breakwater is transformed to the vertical water motion in the breakwater. For large friction coefficient the flow velocitites are depressed and the flow condition becomes faster. The correspondence of the flow velocities to the incident wave is delayed by the increasing friction coefficient. For large cross-sectional areas the flow velocities are increased and the flow condition becomes steady slowly. The correpondence of the flows to the incident wave is advanced by the increasing cross-sectional area. For the same number of rubbles in the horizontal direction and increased number of rubbles in the vertical direction, the flow velocities are increased. This is equivalent to the increase of cross-sectional area and the effectiveness of rubbles also increases. The effective constructing method of the rubble-mound breakwater for wave reflection is to increase gaps among rubbles in the vertically upper zone and to increase the height of the breakwater. Since a large quantity of water enters the breakwater during one wave period if flow velocity is high in the breakwater, the wave reflection decreases at the front of the breakwater. The

number of rubbles in the vertical direction is more important for wave reflection than that in the horizontal direction. The high velocity in the case of large rubble thickness is caused by the pressure difference between the top and the bottom of the rubble layer in front of the breakwater. One cause of the sea bed erosion in front of a rubble-mound breakwater is the wave induced currents. (Baker-IVI)
W85-02271

PNEUMATIC PROTECTION OF LARGE DAMS AGAINST HYDRODYNAMIC PRESSURE FLUCTUATION OF SEISMIC ORIGIN (PROTECTION PNEUMATIQUE DES BARRAGES CONTRE LES SURPRESSIONS HYDRODYNAMIQUES D'ORIGINE SISMIQUE),
F. Biesel.
Houille Blanche, No. 1/2, p 133-138, 1984. 6 Fig.

Descriptors: *Seismology, *Dam stability, *Air pockets, Pressure distribution, Dams, Hydrodynamics, Model studies.

Air pockets distributed all over the upstream face of a dam communicate with the water, providing pneumatic protection for large dams against seismic pressure fluctuations. While the damping effect of such air cushions is readily understandable, a theoretical linearized model is presented to offer quantitative analyses of such phenomena. Although it is linear, the theory appears to give reliable orders of magnitude and shows that pressure fluctuations may be drastically reduced, chiefly for frequencies of a few hertz. Fundamental resonance frequencies of large dams are often in the same range. Detailed computations are provided. (Baker-IVI)
W85-02356

REMOVAL OF SEDIMENT PARTICLES BY VORTEX BASIN,
Tampere Univ. of Technology (Finland).
A. D. Mashauri.
Aqua Fennica, Vol. 13, p 27-33, 1983. 6 Fig, 6 Ref.

Descriptors: *Vortex basins, *Settling basins, *Particulates, Hydrologic models, Clarifiers, Water treatment, Irrigation headworks, Hydroelectric plants, Velocity, Vorticity, Sediments.

The vortex-type settling basin is essentially a 'bath tub' with a central orifice to discharge settled particles. A physical model was constructed to verify the parameters and governing equations of flow, basin settling patterns, and efficiency. Two versions are studied: the horizontal floor type and the sloping floor type. Parameters such as angular velocity, the vorticity force, and the settling efficiency are determined as functions of the inflow discharge, orifice diameter and its ratio to the basin diameter and the particle size. Settling efficiency and amount of water through orifice are given for both versions (horizontal floor and sloping floor) and they show a respectable performance. Settling efficiency is well above 80% for particles as small as 0.125 mm in diameter. The amount of water through the orifice hardly exceeds 15% of the inflow discharge. The basin dimensions are small compared to classical basin. Since the basins can remove particles > 0.2 mm efficiency, their use in hydropower intakes is recommended. Smaller particles can also be removed to some extent, so that the basins may be useful in water supply intakes as primary clarifiers. This type of basin can also be used at irrigation headworks to deter sediment particles from entering the irrigation canals downstream. (Moore-IVI)
W85-02391

PILOT EXPERIMENTS ON THERMAL BAR IN LOCK EXCHANGE FLOW,
McMaster Univ., Hamilton (Ontario). Dept. of Civil Engineering and Engineering Mechanics.
Y. R. Marmoush, A. A. Smith, and P. F. Hamblin.
Journal of Energy Engineering, Vol. 110, No. 3, p 215-227, September, 1984. 5 Fig, 2 Tab, 18 Ref.

Descriptors: *Density, *Thermal pollution, *Thermal bar, *Lock exchange, *Cold regions, Temperature effects, Physical properties, Powerplants, Flow.

In cold climates, the behavior of thermal density currents may be altered when the receiving water is close to the freezing point due to the fact that fresh water attains its maximum density at a temperature of 4 C. The existence of a density extremum in water at 4 C and the resulting nonlinear relation between density and temperature gives rise to densimetric flows, which are markedly different from those in the linear range. Experiments are described that give some insight into the phenomenon of the thermal bar and the manner in which it may influence nearshore transport processes in the vicinity of a thermal outfall in a cold climate. The experiments provide dramatic proof that the existence of an extremum in the density/temperature relation has a profound influence on the behavior of densimetric flow in general and lock exchange behavior in particular. The three zones of interest in the vicinity of a thermal bar are clearly demonstrated: the overflow region, the thermal bar, and the thermal underflow region. The quantitative results were sufficiently good to give a picture of a gradually thickening interfacial layer of maximum density that eventually dominates the flow regime. The location of the thermal bar appears to be strongly linked to the initial density difference, although the scope of the tests and limitations of equipment were such that other influences cannot be ruled out. (Baker-IVI)
W85-02443

EFFECT OF ICE COVER ON HYDROPOWER PRODUCTION,
Clarkson Coll. of Technology, Potsdam, NY. Dept. of Civil and Environmental Engineering.
P. D. Yapa, and H. T. Shen.
Journal of Energy Engineering, Vol. 110, No. 3, p 231-234, September, 1984. 2 Fig, 7 Ref. St. Lawrence Seaway Development Corp. Contract DTSL55-83-CO215.

Descriptors: *Hydroelectric plants, *Electric power production, *Ice cover, *Power Dam, *St. Lawrence Seaway, Energy, Economic aspects, Hydraulic resistance, Frazil ice, Hydraulic roughness.

The loss of power due to the resistance of the ice cover in the 27 mile reach between the Iroquois Dam and the Power Dam on the St. Lawrence River is analyzed. This reach, which includes a steep fast flowing section, is most critical in the ice formation process. The average power loss per winter is about 50,000 MW-hr. Relationships between three parameters that affect the hydraulic resistance of the ice cover are analyzed in efforts to identify major factors that influence the energy loss due to the ice cover. These three parameters are the total cumulative freezing degree-days, the total frazil ice production per unit area, and the Manning's roughness coefficient of the initial ice cover. The power loss can only be related to the initial ice cover roughness. Based on the analysis it is concluded that it is important to form a smooth, stable initial ice cover with a minimum open water area in order to be able to reduce the power loss. Once the initial ice cover is formed, the only means of improving power production would be through the regulation of discharge at the Power Dam. (Baker-IVI)
W85-02444

DYNAMICS OF JETS IN TWO-LAYER STRATIFIED FLUIDS,
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
P. J. W. Roberts, and P. R. Matthews.
Journal of Hydraulic Engineering, Vol. 110, No. 9, p 1201-1217, September, 1984. 11 Fig, 3 Tab, 11 Ref.

Descriptors: *Fluid mechanics, *Jets, *Flows, *Stratification, Hydraulic engineering, Stagnant water, Entrainment, Pumped storage, Density jump.

Experiments were performed on nonbuoyant jets discharging horizontally into a stagnant, two layer stratified ambient fluid. The ambient stratification is characterized by a well mixed upper layer separated by a density jump from a deeper layer which is linearly statified. This is an idealization of the stratification that occurs in lakes, reservoirs, and ocean waters. The discharge is into the lower layer, and the flow situation arises in pumped storage reservoirs during power generation or pump back and in Ocean Thermal Energy Conversion (OTEC) plants in the ocean. The effects of source momentum flux, lower layer stratification, and interfacial density jump were studied for a range of conditions for which the nozzle size exerts only a small influence. The jet behaves initially in a manner similar to that of one in an unstratified fluid, but at some distance from the nozzle, the ambient stratification caused the jet to collapse vertically and spread rapidly sideways. Following collapse, the inflow proceeds as a density current. Depending on the relative strengths of the parameters involved, entrainment from the upper layer into the jet may occur. This type of flow is termed unstable, and one in which no entrainment occurs is termed stable. For stable conditions the flow is entrained selectively into the jet from a layer of finite thickness. Analysis is based primarily on dimensional analysis and length scale arguments and results are presented to predict whether entrainment from the upper layer occurs, the widths and locations of the entrained flow and depth of the ambient mixed by the jet, the total jet volume flux, and the collapsed layer thickness. (Baker-IVI)
W85-02450

LIVE-BED SCOUR AT BRIDGE PIERS,
Auckland Univ. (New Zealand). Dept. of Civil Engineering.
B. W. Melville.
Journal of Hydraulic Engineering, Vol. 110, No. 9, p 1234-1247, September, 1984. 10 Fig, 1 Tab, 13 Ref.

Descriptors: *Scour, *Piers, *Sediments, Sediment transport, Abrasion, Erosion, Bridges, Velocity.

The relationship between scour depth at cylindrical bridge piers founded in cohesionless sediments, and mean approach flow velocity is defined for flows above the threshold of particle motion. Experimental data are collected in which pier size, sediment size and mean approach flow velocity are systematically varied. These data show that the relationship between scour depth and flow velocity differs, depending on whether the bed sediment is ripple forming or non-ripple forming, and separate functions are identified for each case. Both functions exhibit two scour peaks. These occur at the threshold and transition flat bed conditions. Contrary to previous findings, the maximum scour depth is found to occur at the transition flat bed condition in the case of ripple forming sands. For nonripple forming sediments, however, the maximum scour depth occurs at threshold condition. It is expected that local scour depths would be reduced from those for uniform sediment of the same mean size in situations where armoring occurs. (Baker-IVI)
W85-02452

SEEPAGE CHARACTERISTICS OF COARSE GRANULAR MEDIA,
Lincoln Coll. (New Zealand). Dept. of Agricultural Engineering.
V. Sriboonlue, and T. R. H. Davies.
Journal of Hydrology, Vol. 22, No. 2, p 138-151, 1983. 7 Fig, 4 Tab, 26 Ref.

Descriptors: *Seepage, *River beds, *Forchheimer equation, Porosity, Fluid mechanics, Mathematical equations.

Seepage flow through coarse porous materials such as river-bed gravels, rockfill dams, slurry separators, and fish incubators is governed by a nonlinear relationship. The coefficients of nonlinear seepage flow can be estimated from a reformulation of the Forchheimer equation, using grain diameter, porosity and fluid properties. These parameters are measureable by simple tests. This avoids the use of permeameter tests in preliminary investigations of seepage in coarse media. A semi-

empirical procedure is suggested which agrees satisfactorily with data from a range of tests on various coarse granular media. (Baker-IVI)
W85-02557

8C. Hydraulic Machinery

HYDRAULIC MODEL STUDY OF PUMP SUMP DESIGN,
Iowa Univ., Iowa City. Inst. of Hydraulic Research.
A. J. Odgaard, and J. J. Dlubac.
Journal of Hydraulic Engineering, Vol. 110, No. 9, p 1267-1272, September, 1984. 4 Fig, 4 Ref.

Descriptors: *Design criteria, *Hydraulic models, *Sumps, Pumps, Model studies, Scale models.

The results of a model study are reported which suggest that potential flow theory may be used as a guide toward the development of sump design modifications, which may include in-channel turning vanes, and perhaps, may even be used in the development of the conceptual layout of pump sumps. The model study was concerned with a proposed design of a 4-pump sump for withdrawal of cooling water from a natural draft cooling tower at Trimble County Generating Station. The model was constructed at an undistorted scale of 1:10 and was operated according to the Froude scaling law. (Baker-IVI)
W85-02454

COMMISSIONING PUMPS AND PUMP-TURBINES,
Brown and Root Development, Inc., Houston, TX.
B. Eyden.
International Water Power and Dam Construction, Vol. 36, No. 8, p 23-28 and 33-34, August, 1984. 5 Fig, 12 Ref.

Descriptors: *Design criteria, *Pumps, *Turbines, *Planning, Water resources development, Construction, Safety, Economic aspects.

Inadequate or poorly planned commissioning programs can lead to costly delays or even damage. These problems become particularly onerous with increasing unit size. A well designed and properly implemented commissioning program is increasingly important. A test procedure is outlined which constitutes a minimum for placing a hydraulic turbine or pumped turbine in commercial service with reasonable assurance of safe and satisfactory operation. Principal advantages to be gained from such a proceedure are in the line of safety, meeting contractual requirements, unit system operation, design innovations, reference standard, and personnel training. (Baker-IVI)
W85-02674

GEARS FOR PUMPED-STORAGE UNITS,
Allen Gears Ltd., Pershore (England).
B. J. Marsh, and G. L. Lack.
International Water Power and Dam Construction, Vol. 36, No. 8, p 37-38, August, 1984. 2 Fig, 1 Tab.

Descriptors: *Pumped storage, *Gears, *Mechanical equipment, Design criteria, Water management, Water resources development.

Due to the limitations in turbine runner design and the high cost of two-speed electrical machinery of the multi-pole, tandem mounted or solid state control type, a compromise is usualy accepted which never attains optimum operational efficiency in either the generating or pumping mode. A method does exist which enables considerably higher efficiencies to be obtained at an installation cost which could be recovered within a relatively short time. The method involves the installation of an epicyclic gear between the electrical machine and the turbine runner. The gear unit offers two possible speeds so that the synchronous speed of the electrical machine could remain constant while the runner would operate at its most efficient speed in the pumping and turbine modes. An example of the application of such a gear is offered. (Baker-IVI)
W85-02676

BEHAVIOUR OF HYDRAULIC MACHINES UNDER STEADY OSCILLATIONS,
Hydroart S.p.A., Milan (Italy).
G. Borciani.
International Water Power and Dam Construction, Vol. 36, No. 8, p 45-49, August, 1984. 11 Fig, 10 Ref.

Descriptors: *Hydraulic equipment, *Resonance, *Pumped storage, Oscillation, Design criteria, Turbine, Pumps.

Applications of a code designed to define the resonant frequencies in a hydraulic circuit at the Lete-Sava pumped storage plant are described. The plant has a 3 m diameter head-race tunnel, followed by a penstock of 2.3 m diameter. A cylindrical surge shaft, 9.5 m in diameter and upstream of the penstock, has an inlet throttle. The penstock supplies two units consisting of motor-generator, Pelton turbine and four-stage centrifugal pump through a branch pipe. This hydraulic system was excited in different operating conditions in generation and in pumping by injecting a sinusoidal electric signal into the governor of the four needles of turbine number 2. Numerous different pressure measurements were carried out, but the pressure response measured at point P20 is used to explain the methods used in interpreting the measurements. While such interpretations are not easy, the method employed has provided useful results. (Baker-IVI)
W85-02677

MEASUREMENT OF REAL TIME TURBINE EFFICIENCY,
Westinghouse Oceanic Div., Annapolis, MD.
G. P. Erickson, and J. C. Graber.
International Water Power and Dam Construction, Vol. 36, No. 9, p 15-17, September, 1984. 4 Fig.

Descriptors: *Turbines, *Efficiency, *Optimization, *Economic aspects, Design criteria, Water managment, Planning, Computers.

Real time efficiency measurement of hydroturbine generators can be provided today. The utilities recognize the need in terms of the loss in revenue that inefficiencies create. Losses of more than $100,000 per turbine per year can result from either turbine inefficiencies or increased penstock losses. These losses can go undetected for some time because of the difficulty in identifying them. A system designed to satisfy these requirements has been built by the Ocean Division of Westinghouse. Designated the LEFM-824, the system includes a Hewlett packard HP-85 desktop computer to perform the necessary computations. Whether this or a simpler system is used, on-line, the overall plant efficiency measurement is available today at virtually no risk to the utility. The economic payback period of such a system could be as little as six months. (Baker-IVI)
W85-02678

RESONANCE SENSITIVITY OF HYDROPOWER AND PUMPING STATIONS,
Institute of Hydraulic Engineering Research, Bucharest (Romania).
M. Popescu, and A. Halanay.
International Water Power and Dam Construction, Vol. 36, No. 9 p 25-28, September, 1984. 6 Fig, 6 Ref.

Descriptors: *Hydroelectric plants, *Design criteria, *Resonance, *Pumping stations, Optimization, Surge tanks, Air chambers.

Comparative analysis of resonance diagrams for several hydropower and pumping stations with surge tanks and air chambers shows large differences in the maximum resonance pressures. A strategy is advocated which consists of hydraulic resonance computations coupled with practical surveillance measures during the operation of resonance sensitive hydraulic systems. A fundamental hydraulic scheme is considered consisting of a reservoir, a pressure tunnel, a surge tank, a penstock and a turbine combined into a hydropower station. It is suggested that for each hydraulic surge system it is necessary to carry out special resonance analyses following the normal procedure to obtain the resonance sensitivity. For hydraulic systems which are resonance sensitive, special electronic equipment should be used to measure non-stationary pressures of the water in the conduit as a way of continuous surveillance during functioning. (Baker-IVI)
W85-02681

8D. Soil Mechanics

DAM OF ARGILLITES AND SILTSTONES,
S. S. Golik.
Hydrotechnical Construction, Vol. 17, p 633-639, December, 1983. 4 Fig, 2 Tab, 3 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 12, p 29-33, December, 1983.

Descriptors: *Dam construction, *Earth dams, *Crimea, *USSR, Soil properties, Alluvial deposits, Seepage, Settlement, Argillites, Siltstones.

A dam was constructed with a loam core and shoulders of low strength argillites and siltstones to create a river reservoir for water supply of a resort region and irrigation of lands in arid places in Crimea. A spillway and intake structure were constructed next to the dam. The reservoir is located in a river valley on the north slope of the Crimean mountains composed of the Taurian Series which consists of flysch intercalating argillites, siltstones, and thin layers of sandstone. Seepage investigations of the soils of the dam foundation were carried out in the alluvial deposits of the valley floor by single and group pumping tests. The successful use of low-strength argillites and siltstones in this dam showed that these soils can be used widely in dam construction. The transport costs for hauling the soil masses were markedly reduced by placing soils of useful excavations into the dam. The location of the borrow pits in the flood zone reduced the area of lands allocated for construction and loss of agricultural production. The year-round excavation and placement of argillites and siltstones in the dam accelerated the construction of the structures and delivery of water to consumers. The observed operating settlement of the dam was considerably less than the predicted, which evidently is related to the gradual soaking of the Taurian soils from the reservoir as it filled during construction. (Baker-IVI)
W85-02231

POST-CONSTRUCTION DEFORMATION OF ROCKFILL DAMS,
Scott, Wilson, Kirkpatric and Partners, Basingstoke (England).
R. P. Clements.
Journal of Geotechnical Engineering, Vol. 110, No. 7, p 821-840, July, 1984. 9 Fig, 7 Tab, 67 Ref.

Descriptors: *Construction, *Rockfill dams, *Deformation, Mathematical equations, Safety, Deformation, Settlement, Camber.

A study was made of the post-construction crest settlements and deflections of 68 rockfill dams in order to assess the usefulness and accuracy of the prediction of such deformations using empirical equations. Graphs of deformation per unit height against time are plotted for membrane-faced (dumped and compacted rockfill), sloping, and central core dams. These predictions can be used in determining the requisite camber and provide an early warning system of problems within the dam. Existing methods are based on simple empirical relationships of displacement with height or time. The errors involved are considered to be too significant to allow reasonable predictions to be made. An alternative approach is proposed, based on the comparison with dams having similar characteristics. Details are given in tabular form for each of the dams in the survey, as an aid to this approach. (Baker-IVI)
W85-02257

STEADY FLOW CALCULATIONS FOR CUTOFF WALL DEPTH VARIATION,

National Technical Univ., Athens (Greece). Dept. of Civil Engineering.
E. C. Kalkani, and A. J. Michali.
Journal of Geotechnical Engineering, Vol. 11, No. 7, p 899-907, July, 1984. 7 Fig, 2 Ref.

Descriptors: *Groundwater movement, *Seepage, *Earth dams, Cutoff wall, Foundation failure, Dam failure, Safety, Dam foundations.

The flow through the permeable foundation of an earth dam with an impervious core and an impervious cutoff was studied. Different permeability ratios (Kx/Kz) of the foundation and depths of the cutoff in the foundation were considered. It is shown that calculation of flow through the dam and the foundation may be simplified for cases where Kx/Kz = 10 and 100, and a range of cutoff depth from 35 to 100% in the foundation. Such simplifications in the study of groundwater seepage through the dam and its foundation will give no more than 10% excess flow for the cases described. The simplified calculations can be performed as well by hand. For other cases of Kx/Kz and cutoff depth, more sophisticated techniques will be required to model accurately the seepage through the dam and its foundation. (Baker-IVI)
W85-02258

LATERAL BULGING OF EARTH DAMS,
W. L. Waler, and J. M. Duncan.
Journal of Geotechnical Engineering, Vol. 110, No. 7, p 923-937, July, 1984. 9 Fig, 5 Tab, 4 Ref.

Descriptors: *Earth dams, *Dam failure, *Deformation, *Stress, Dam construction, Safety, Embakments, Earthworks, Pressure.

Many earth dams exhibit lateral deformation during construction. The extent is dependent on the stress-strain characteristics of the embankment material. Earth dams constructed exclusively of impervious fill have the capacity to exhibit extensive plastic deformation or bulging of the embankment mass, caused mainly by molding water contents in excess of optimum. The analyses of two recently constructed earth dams and the review of earlier constructed dams have led to the development of a simplified procedure for predicting the extent of lateral bulging. The high degree of saturation and the corresponding large horizontal deformations seen at the embankments of Truscott, Skiatook and Otter Brook Dams are a direct consequence of the placement of embankment material considerably wetter than the optimum compaction water content. The high degrees of saturation of the embankment materials also resulted in excess pore pressures with increased loading. At Skiatook Dam, the shear strength was so low that there was serious risk of embankment slope failure. At Truscott and Otter Brook Dams there was little risk of instability in spite of the large deformations of the embankments. The rigid, unyielding foundations at these dams were a precipitating factor for the bulging. The cracking of the slope surfaces at Truscott and Skiatook Dams appeared to be mainly a consequence of the air-dried surface crusts that formed on these embankments. (Baker-IVI)
W85-02259

PROBLEMS WITH FARM DAMS BUILT IN DROUGHTS,
K. Nelson.
Aqua, Vol. 23, No. 3, p 20-22, June, 1984. 11 Fig, 3 Ref.

Descriptors: *Droughts, *Dam construction, *Dam stability, *Soil moisture, Stability, Dams, Construction.

An essential ingredient for good dam construction is correct moisture content of the soil. This allows maximum soil density to be achieved by compaction. Dry soil resists compaction because of the friction between adjacent particles. The soil will therefore remain brittle and liable to cracking. The difficulty with adding water while building is that of ensuring its even distribution within the soil. This is a special problem with clays. The main causes for failure are cracking, piping, slides and settlement. Cracking takes two forms, longitudinal and transverse. Longitudinal cracks develop roughly parallel to the length of the dam and penetrate the crest vertically. Transverse cracks are far more dangerous because they run straight through the dam. Another dangerous type of crack is the shrinkage crack. Sometimes seeping water creates a tunnel or pipe along a line of weakness through the dam commencing at the downstream side and working back to the reservoir. Another interesting piping failure is one which develops in the foundation, not in the bank. Piping can also occur along outlet pipes if inadequately constructed and bedded into the bank and foundations. Slides can be of the deep downstream, shallow downstream, and upstream varieties. All poorly compacted dams settle with time; the higher the earth fill, the greater the likely settlement. Remedial work for each of these problems is briefly discussed. (Baker-IVI)
W85-02359

DEFLECTION MEASUREMENTS OF THE UPSTREAM ASPHALTIC MEMBRANE OF MARCHLYN DAM,
A. D. M. Penman, and A. Hussain.
International Water Power and Dam Construction, Vol. 36, No. 9, p 33-37, September, 1984. 9 Fig, 8 Ref.

Descriptors: *Measuring instruments, *Deflection, *Marchlyn Dam, *Wales, *Asphaltic membranes, Membranes, Reservoirs, Pumped storage, Deformation.

Marchlyn dam forms the upper reservoir of the Dinorwic pumped-storage scheme in North Wales. It is one of the first British dams to use an upstream asphaltic membrane as the watertight element. As part of a study of its behavior under loading from the reservoir water, deflections were measured over its full height on the major section where the dam was 72 m high. The simple trolley device that was developed to measure membrane deflections is described and the results of these measurements are discussed. The observed deflections of the membrane have shown that the dam is stiffer than expected, and that the rockfill and moraine provided excellent support for the asphaltic concrete. The measured local deflection adjacent to the concrete plinth was expected but its small magnitude has provided evidence that the membrane was not overstrained at this critical position. The overall accuracy of the simple apparatus was not sufficient to provide a correct measurement of deformation at the crest and it was necessary to rely on independent measurement of crest movements by precise surveying. (Baker-IVI)
W85-02682

8E. Rock Mechanics and Geology

COMMENTS ON CALCULATION OF THE STRESS STATE IN AN ANISOTROPIC ROCK FOUNDATION,
V. P. Merzlyakov.
Hydrotechnical Construction, Vol. 17, p 615-617, December, 1983. 2 Fig, 9 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 12, p 19-20, December, 1983.

Descriptors: *Dam construction, *Mathematical equations, *Stress, *Foundation rocks, Rocks, Anisotropy, Hydraulic engineering.

Rock foundations of dams are often transversely isotropic. Some works recommend K. Wolf's now classical solution for calculating the stress state in this case. The formulas for stresses in this solution were obtained as a result of solving the equation of the two-dimensional problem of elasticity theory in the specified form. This equation is not applicable to foundations with inclined layers and the resultant of the internal forces obtained by integration of the formula is not equal to the vector of the external forces. To eliminate these shortcomings, the solution of the two dimensional problem in which the principal directions of elasticity can differ from the direction of the coordinate axes should be used. (Baker-IVI)
W85-02228

SEISMIC HYDRODYNAMIC FORCES ON ROCK SLOPES,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
J. Ghaboussi, and A. J. Hendron, Jr.
Journal of Geotechnical Engineering, Vol. 110, No. 8, p 1042-1058, August, 1984. 17 Fig, 1 Tab, 10 Ref.

Descriptors: *Finite element method, *Slopes, *Reservoirs, *Hydrodynamics, *Seismology, Earthquakes, Hydrodynamics.

A finite element method of analysis for seismic response of fluid structure problems is presented. Displacement model finite elements are used in the fluid region, leading to simple fluid-structure interface conditions. The method has been used in a parametric study of seismic hydrodynamic forces on rock slopes. Parameters considered are height of the slope, depth of water, slope of the rock face, and the earthquake base motion. A method for evaluation of seismically induced movements of submerged rock slope is presented. The compressibility of water, the fluid-structure interaction and the effect of the foundation have been included. The distribution of maximum hydrodynamic forces on the rock slopes is quite different than those predicted by the assumption of rigid wall and incompressible fluid. The coefficient of maximum hydrodynamic force is fairly insensitive to the height of the slope and the depth of the water in the reservoir. It is only affected to a certain extent by the angle of inclination of the rock face. The effects of the geometry and the earthquake input are briefly described. For complex geometries both magnitude and distribution of the hydrodynamic forces are affected and individual analyses may be required for each different geometry. The magnitude of the hydrodynamic forces can be strongly influenced by the earthquake input. In a limiting equilibrium analysis the peak values of the ground acceleration and the hydrodynamic forces are used to calculate a factor of safety. (Baker-IVI)
W85-02262

8F. Concrete

CRACKING IN REINFORCED CONCRETE ANALYSIS,
North Carolina State Univ. at Raleigh. Dept. of Civil Engineering.
A. K. Gupta, and H. Akbar.
Journal of Structural Engineering, Vol. 110, No.8, p 1735-1746, August, 1984. 5 Fig, 1 Tab, 12 Rf. NSF grant DAR-8018554.

Descriptors: *Reinforced concrete, *Cracks, Mathematical analysis, Model studies.

An idealized simple model of forming cracks in reinforced concrete has been presented. It is assumed that the cracks are formed in the direction of the major principal tensile strain and the direction can change with the change in strains. It leads to crack directions which are consistent with the limit state. That the cracks would change directions is evident by the available experimental results. A numerical algorithm suitable for step-by-step finite element analysis has been developed. It is shown that the numerical algorithm gives results identical to the theoretical results, thus validating the algorithm. The algorithm is also applied to limited available experiments. The proposed crack model and the numerical algorithm have been successfully incorporated into a finite element program. (Baker-IVI)
W85-02273

8G. Materials

CALCULATION OF THE WATERTIGHT EFFICIENCY OF LINING WITH FILM MEMBRANE,
Yu. M. Kosichenko.

Hydrotechnical Construction, Vol. 17, p 640-647, December, 1983. 2 Fig, 2 Tab, 10 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 12, p 33-38, December, 1983.

Descriptors: *Linings, *Membranes, *Permeability, Canal linings, Design criteria, Tunnels, Coatings, Seepage, Mathematical equations.

Watertight linings and membranes with the use of polymer films are finding wide use to prevent seepage of water from canals and impermissible rise of the groundwater level in the near-canal zone. The most common are watertight linings of polymer film with a protective covering of concrete or soil, so-called concrete-film and soil-film linings, which are presently considered the most efficient with respect to watertight qualities. In general, the permeability of watertight linings should be calculated from the condition that the seepage flow rate through the lining is equal to the sum of the individual seepage flow rates through individual damages and defects of the film membrane on a given area of the lining. The performance of the calculations during design stages will make it possible to more correctly and validly select the type of watertight linings in relation to the particular hydrogeological conditions and to formulate the requirements imposed on the quality of their construction with a prediction of the expected efficiency of the canal. During operation of canals with watertight linings, one can calculate seepage losses and efficiency and give well-founded recommendations on the need to conduct repair works on individual stretches. (Baker-IVI)
W85-02232

8I. Fisheries Engineering

EFFECTS OF FEEDING RATES ON PRODUCTION OF COMMON CARP AND WATER QUALITY IN PADDY-CUM-FISH CULTURE,
Indian Council of Agricultural Research, New Delhi.
For primary bibliographic entry see Field 5B.
W85-02236

LERDERDERG RIVER FISH-LADDER,
J. P. Beumer.
Aqua, Vol. 23, No. 3, p 16-17, June, 1984. 8 Ref.

Descriptors: *Fish ladders, *Fish management, *Dams, *Weirs, *Lerderderg River, *Australia, Fish, Barriers, Design criteria, Evaluation.

A study was undertaken to examine the movement of fish through a fish ladder installed in a diversion weir on the Lerderderg River. The River is a 60 km long tributary forming part of the Werribee River coastal drainage. The Merrimu Reservoir Project providing a domestic water supply for Melton and Bacchus Marsh involved construction of diversion weirs on Goodman Creek and the Lerderderg River. The ladder incorporates 42 steps with a trap bay at step 36. It has a slope of 1:10. A Nylex plastic screen covering the ladder prevents fish escaping and reduces the amount of leaf-litter and other debris falling into the ladder. A two way trap covered by a fine mesh was installed in the trap bay to monitor fish usage of the ladder. Monitoring of the trap and electrofishing were carried out on a weekly basis for 21 weeks. A total of 69 specimens were taken in the trap during the monitoring period, about half in each trap section. While the fish ladder design was suitable for the larger river blackfish and larger brown trout, few smaller specimens of these two species were caught in the trap. The other three species, short-finned eel, roach and Australian smelt, were poorly represented in trap catches suggesting that they could not cope with the fish-ladder in its then existing design. A number of design modifications to the ladder and alterations to the flow pattern downstream of the spillway should improve the efficiency of the ladder. (Baker-IVI)
W85-02358

EXPERIENCES GAINED IN RESTORING A WILDERNESS RIVER,
Kuopio Water District Office (Finland).
For primary bibliographic entry see Field 5G.
W85-02386

HYDRAULICS OF DENIL FISHWAYS,
Alberta Univ., Edmonton. Dept. of Civil Engineering.
N. Rajaratnum, and C. Katopodis.
Journal of Hydraulic Engineering, Vol. 110, No. 9, p 1219-1233, September, 1984. 9 Fig, 1 Tab, 8 Ref.

Descriptors: *Fish management, *Fish ladders, *Denil fishways, Hydraulic engineering, Flow, Hydraulic structures, Design criteria.

An experimental study was performed on the hydraulics of simple Denil fishways. For the Standard Denil, the characteristic velocity profile that exists in the fully developed flow region is found. In the central region of the fishway the velocity increases from lower values in the bottom portion of the fishway to a high velocity surface stream. A rating curve is developed for the Standard Denil, which would be very useful in the design of Denils over a range of bed slopes and discharges. Some assessment has also been made of the effect of changing the width ratio and baffle spacing ratio from the standard values. (Baker-IVI)
W85-02451

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